MACHINE DESIGN

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This Month's Cover: Taking MACHINE DESIGN'S annual Directory of Materials supplement to the October issue as a theme, artist Kenneth Ives suggests dramatically the great importance of materials selection and specification as well as the variety available and the various forms produced.

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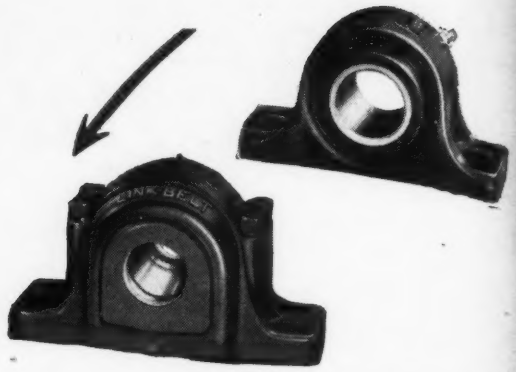

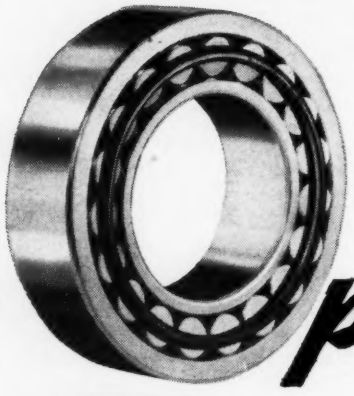

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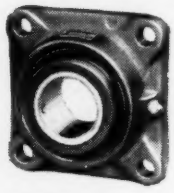

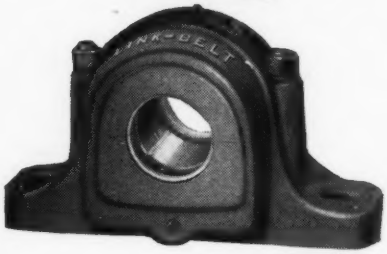

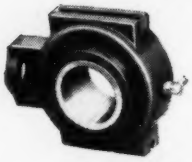

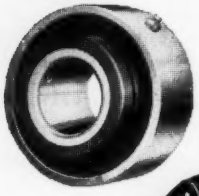

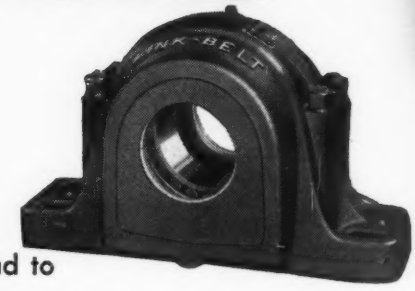

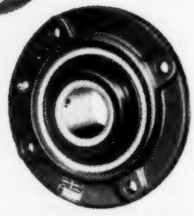

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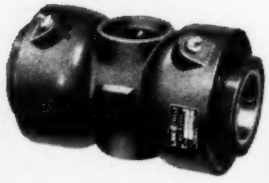

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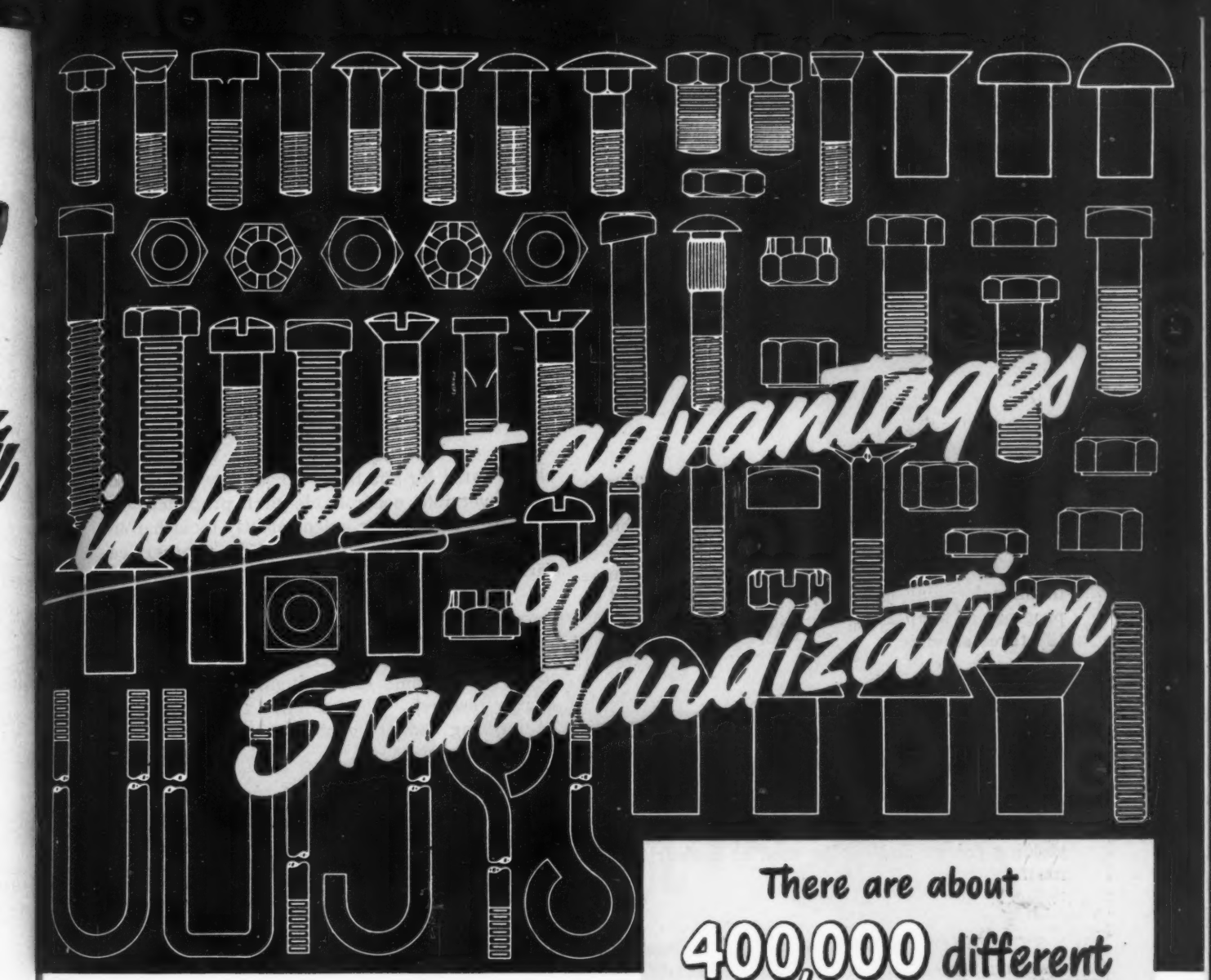

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Topics

SIMPLIFYING spare parts supply and maintenance for industrial engines used by the Army, Navy and Air Force has been undertaken by the Munitions Board. Its committee is composed of ten representative executives of the industrial engine industry as part of its overall program of simplification of equipment used by the three services.

ATOMIC PLANTS probably will create more nuclear fuel than they use while generating power. Atomic reactors yield heat energy when nuclei of atoms of uranium 235 are split. At the same time nuclei of uranium 238 are transmuted to plutonium which is also capable of yielding energy and can be used as nuclear fuel itself.

SYNCHROTRON atom smasher for nuclear research is being built by General Electric for Queens University, Canada. A 70-million volt unit, it will be modeled after a machine being used in the G-E research laboratory.

PEAK of mechanical invention in this country and Europe occurred between 1850 and 1875, according to Pitirim Sorokin of Harvard. Sorokin has in mind the number as well as the originality of inventions. The prolific development of electrical and mechanical devices in recent years has been almost wholly the exploiting of older inventions.

MACHINE TOOL exhibition in Britain is the first since 1934, showing the products of more than 230 firms. Indications are that British output for the current year will exceed $120 million in new metal-working machine tools, almost five times the output in 1934.

NONRIGID airship for the Navy will have a helium capacity of 825,000 cubic feet. This type N airship will be designed by Goodyear Aircraft Corp. and will be the largest aircraft of its type ever contracted for by the Navy. Engines will be enclosed within the car and will be accessible for repair and maintenance in flight. Powerplants will be radial, air cooled, C7-BA1 Wright Cyclones rated for 800 hp at takeoff. Two eighteen-foot reversible, controllable-pitch propellers can be driven together or independently by either engine. Tricycle landing gear will be another feature of the blimp.

VACUUM ENGINEERING has grown to manhood as a result of developments in atomic-energy research. The full import of this type of engineering cannot be imagined but it will certainly be great.

DRY LUBRICANT, consisting of molybdenum disulfide powder, adheres to surfaces with light rubbing. Having a low friction coefficient, this lubricant known as Molykote has a capacity for preventing galling, seizing, or metal-to-metal contact at bearing pressures over 100,000 psi at either high or low sliding velocities.

KRYPTON gas is now being used in Westinghouse fluorescent lamps, giving an 85-watt lamp the same characteristics as 100-watt argon-filled lamps. The krypton gas provides a 17 per cent gain in efficiency.

PRESSURIZED SMELTING, a process whereby the hot gases of a blast furnace are partially sealed by a system of valves, has been successfully tested in two converted blast furnaces at Cleveland and Youngstown. In building up the presure within the furnace, the method provides for higher temperatures, thereby speeding the chemical processes of smelting.

SALT-SODIUM DICHROMATE solution, in place of the salt usually employed for snow and ice removal on municipal streets, has reduced corrosion of auto fenders and bodies in a test program carried out by Goodyear Tire and Rubber Co. The chromates reduce salt corrosion to one-third its original intensity and arrest "trapped salt" corrosion at body and fender joints that continues throughout the summer.

MACHINE DESIGN

Steels and Their Treatment

Fig. 1—The best, most economical steel for jobs such as these requires adequate study of both steels and their respective heat treatments

By Norman N. Brown
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Part I–Selection

AS THE design of machines, parts and mechanisms has developed and improved, so have steels to satisfy design requirements. Along with increase in the number of steels available has come a natural increase in the methods of treating and conditioning these steels for service. To determine which of the varied steels and treatments should be used for a particular job has become a complex problem as more and more specialized heat treatments have become available, *Fig.* 1. It is the purpose of this article to discuss some of these steels and their treatment in a general way which may be of assistance to the designer in selecting the most desirable steel as well as in specifying its subsequent heat treatment.

In the early days of steel making practically all

steels were of the plain carbon variety that had to be hardened in water. Gradually alloy steels were developed which could be hardened with the slower oil quench. Then, of course, carrying the slower cooling further the highly alloyed air hardening tool steels came into the picture. Both the "through hardening" and "case hardening" grades were parallel developments.

The adding of alloying elements to steel results in two closely related effects; namely, improving physical properties, and slowing down the cooling rate necessary to harden and obtain the desired physical properties. It will be observed from this that alloy steels should generally be heat treated to get the most out of them and should be used on jobs that require better physicals than obtainable with plain carbon steels.

Selection Factors

In selecting a steel and heat treatment for a specific part there are, generally, five points to be considered: (1) Physical properties, (2) distortion, (3) price, (4) availability, and (5) processability.

PHYSICAL PROPERTIES: The primary problem is to ascertain to what forces a part will be subjected so that qualities such as toughness, wear resistance, fatigue strength, torsional strength, etc., can be determined and the proper steel and heat treatment (if required) selected. Often there are times when the designer does not know how a certain part will react in service and he has to resort to some "trial and error" methods. In such cases it is usually best to start with a steel that is fairly certain to be better (and at the same time more expensive) than required and work down from there. The extent to which this can be done depends, of course, upon the time, facilities and money available.

DISTORTION: This point varies in importance with the part. Both the selection of the steel and heat treatment vary in importance accordingly. Usually the alloy steels with the slower cooling rates in hardening distort less than those with the faster cooling rates. They also cost more.

PRICE: Use of a more expensive steel than necessary occurs in many cases, but an analysis of the situation beforehand can reduce this tendency materially. For instance, some alloy steels respond exceptionally well to heat treatment in large sections (4-inch diameter and over) or when heat treated to high hardnesses (40 to 50 Rockwell C), but in smaller sections or lower hardnesses may not show up appreciably better than a lower-priced alloy steel so it is well to check this point. Excessive overdesigning of a part also contributes to needless expense by requiring a higher-priced steel than necessary.

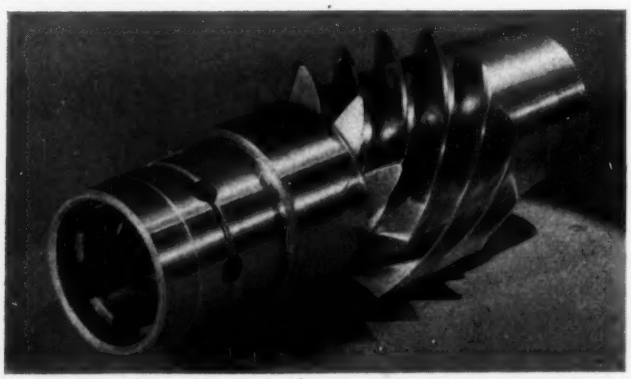


Fig. 2—Heavy-duty feed drive worm machined from hot-rolled A4615 and case carburized for maximum wear resistance, strength, toughness and low distortion

Alternate Steels Can Be Used

AVAILABILITY: There are only a few isolated cases where only one steel will do a job economically. Whereas one steel may admittedly have been found best for a particular part, usually there is at least one, or perhaps several other analyses, that could be used without very much financial sacrifice or sacrifice in physical properties relative to the part. Therefore, especially at this time with the yet somewhat limited grades of prewar steels on the market, it behooves the steel user and steel company representatives to go over the situation together if the circumstances justify such action. The designer certainly will not lose any friends in the purchasing department or shop if his drawings indicate the grade of steel preferred with the added note "or equivalent"; or, better still, list acceptable alternates. Following are brief groupings of standard steels. Those in any one group may be used interchangeably in varying degrees depending upon the specific parts involved:

AISI	AISI	AISI	AISI	AISI
C1020	A2315-20	C1040-50	A3140-50	A4340
C1117	A3115-20	C1137	A4140-50	A3250
A1315	A4615-20	A1335	A5145	
	A5120		A8740-50	
	A8620		A9442-50	
			A6145	
			A8645	

There are, of course, many other grades including

JUST WHICH STEEL should be used for a particular design and, equally important, just which treatment for that steel will provide the desired physicals at minimum cost is an ever-present complex problem confronting the designer. In this two-part series, the author has attempted to provide the designer with a factual, down-to-earth discussion of steels and their treatments, emphasizing the importance of giving adequate consideration to both phases of the subject. His long experience in working with designers in solving their steel selection problems should prove of much practical value in crystallizing thought regarding this involved though interesting subject

"tradename" steels not included on this brief list. It can be enlarged or revised, and steels checked for availability with the various steel companies according to the needs of the individual concerns. As far as tradename steels are concerned, most of them are back on the market with their prewar or even with an improved chemistry. Those marketed by reputable concerns were developed to fill gaps as far as physical properties and prices are concerned in the standard SAE and AISI setup. Competition compels their price be in line with similar standard grades so there need be no fear in considering them along with or as an alternate for a standard specification, and furthermore, many years' experience has proved they can "stand on their own feet", not having to take a back seat to other steels in the industry.

PROCESSABILITY: Frequently the speed with which a steel can be machined is an important factor in its selection. It may be a production part which has to be made quickly in large numbers or it might be a single part with a number of intricate machining operations involved. In such cases good machinability is particularly desirable. The resulphurization of some steels is a definite aid to machinability. Most of the so-called screw machine steels are high in sulphur and machine exceptionally well, but they are not to be confused with the resulphurized grades. The high-sulphur screw machine steels are made from ores high in sulphur and during the steel making process only the sulphur in excess of the amount required by the particular specification is removed. On the other hand, in the case of the resulphurized steels, most of the sulphur is removed in the course of manufacture. Then the percentage of that element permissible without causing objectionable features, such as brittleness, is added to balance it carefully against the other elements, particularly manganese.

TABLE I

Comparative Steel Machinability Ratings

AISI Spec.	Finish	Heat Treat*	Brinell Hardness	Machinability (Per cent)
E1112	Cold	No	174	100
C1010	Cold	No	124	50
C1010	Hot	No	109	44
C1020	Cold	No	146	58
C1020	Hot	No	128	52
C1117	Cold	No	162	82
C1117	Hot	No	135	75
A1315	Cold	No	170	94
A1315	Hot	No	149	88
A2315	Hot	No	170	50
A3115	Hot	No	170	52
A4615	Cold	No	197	70
A4615	Hot	No	175	65
C1045	Cold	No	210	60
C1045	Hot	Ann.	175	62
C1045	Hot	Yes	235	50
C1137	Hot	No	190	75
A1335	Hot	Ann.	200	60
A3140	Hot	Ann.	207	50
A3140	Hot	Yes	286	37
A4140	Cold	No	248	52
A4140	Hot	Ann.	183	55
A4140	Hot	Yes	285	38
A4150	Hot	Ann.	197	52
A4150	Hot	Yes	302	34
A5140	Hot	Ann.	207	50
A5140	Hot	Yes	269	38
A4340	Hot	Ann.	228	55
A4340	Hot	Yes	293	38
A3250	Hot	Ann.	228	40
A3250	Hot	Yes	302	29
A6145	Hot	Ann.	205	49
E52100	Hot	Ann.	228	35

Note—This chart should be used as a guide only as conditions will vary somewhat in different plants with different tools and different heats of steel.

* "Ann." indicates annealed condition.

RESULPHURIZED STEELS: One or two steel companies pioneered in making resulphurized alloy steels and have developed a wide business along that line. Recent developments in our larger companies, particularly the automotive, indicate that the few existing prejudices against resulphurization are rapidly disappearing and more of that type steel will become available both in the tradename and standard steel brackets. Another element added to steel that aids machinability is molybdenum. In TABLE I the relative machinability of a number of standard steels is given to aid in judging this characteristic.

AISI Designations Preferred

It will be noticed that throughout this article the standard steels are referred to with AISI numbers. The American Iron and Steel Institute numbering system is fast superseding the old SAE numbering setup and is not causing any great amount of confusion during the transition period. The change is relatively small, for instance, SAE 1020 is now AISI C 1020, SAE 4340 is now AISI A 4340 (or E 4340 if it happens to be an electric furnace product), etc.

HARDENABILITY: At this point it might be well to say a word about hardenability and its importance to the designer. It is now possible to obtain steels that have been tested as to their exact hardening power (Jominy test), which is of interest to those

Fig. 3—A group of special heavy-duty gears and pinions made from A4145 steel heat treated to a hardness of 50 Rockwell C

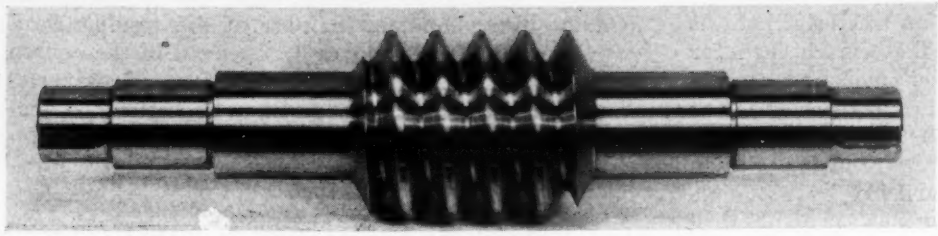


Fig. 4—Worm for a truck winch made from resulphurized steel to allow machining after hardening to a hardness of 38 Rockwell C

making particularly fussy or critical parts on a production basis. With Jominy figures available a definite heat treating procedure can be set up and used without changes.

At the present time, however, one of the principal uses of this Jominy hardenability test is in quality control at the steel mill. The different heats of the steel being melted (usually the heat treating steels over 0.35 carbon) are tested and those possessing high hardenability are rolled into the larger sections while those with low hardenability are rolled into the smaller sections. Thus the user is assured of more uniform results in heat treating. It is recognized that the average steel user cannot afford to keep excessively involved records and different *heats* of the same grade of steel separate in his shop (it is sometimes a problem just to keep the different *grades* separate so that the right one is selected for a job). Therefore, it is the responsibility of the steel company to furinsh uniform material and that, as mentioned before, is where hardenability test helps out.

HARDENING: Occasionally reference is made to "through hardening steels". By that is meant steels containing more than 0.30 per cent carbon as contrasted to steels of lesser carbon content which do not have the ability to develop much hardness with the usual quenching and tempering treatments. Outside of the high-carbon alloy and tool steel grades, most of the through hardening steels are used for parts requiring between 225 to 500-Brinell (20 to 50 Rockwell C) hardness. These steels are used when greater tensile strength and higher yield are required than are obtainable with low-carbon carburizing steels. A common example of this is on highly stressed studs which have to resist a strong pulling action. Another example is on heavy-duty armature shafts which have to be tough and resist a strong torsional stress.

Elasticity Factor Must Be Considered

While on the subject of hardness in relation to toughness, a point comes to mind that is frequently misunderstood; namely, the relation of hardness to the tendency of a steel to bend or whip within the permanent set or yield point of the steel. The modulus of elasticity of all steels is approximately the same for any given section and length. The overlooking of this fact has caused much untold and unnecessary trouble on shafts and other parts subject to bending stresses and its importance can not be over-emphasized. If the designer has the problem of overcoming the bending of a shaft within the elastic limit of a steel—it might be a motor shaft, fan shaft, or axle—about the only procedure possible is to redesign the part to obtain more support or bearing surface, or employ a shaft with a larger cross section. The use of another steel or a different treatment will not often, in itself, eliminate the undesirable bending.

TYPES OF STEELS: It is not the purpose of this article to discuss all the steels on the market, but rather to point out their possible uses by groups which may act as a guide in the proper selection for various jobs. These groups can be roughly divided into four sections: Low-carbon steels, medium-carbon steels, high-carbon water and oil hardening steels, and stainless steels.

Low-Carbon Steels

Low-carbon steels are those in the 0.10 to 0.25 per cent carbon range. Price is usually lower than for those in the higher carbon classifications; the difference is not very much between this and the medium-carbon group and it is generally the amount of alloys in the steel that determines the price. As noted in TABLE I, the machinability varies with the type. Cold working increases the strength of most steels and the low-carbon steels are no exception in this respect. The material may be drawn cold and worked up from that state. Shot peening is another form of cold working that can be used on finished parts to increase their strength without resorting to heat treating.

SCREW STOCK (AISI B 1112, X 1315, etc.): As the name implies these are free machining grades adaptable for screw machine or turned parts on which the working stresses are negligible or for those on which critical stresses are not anticipated. This material is usually furnished in the cold-drawn condition because the closer tolerances held are necessary for economical screw machine operation. Also, in addition to increasing the physical properties somewhat, cold-drawn steel machines better than hot-rolled material. Parts made from these grades are weak when compared to those made from alloys, but the steels nevertheless have a wide market. They may or may not be case hardened as the circumstances demand.

PLAIN CARBON (AISI C 1020, cold-rolled): This material is used for pins, shafts, etc., where the highest physical properties are not of primary importance. It is often case hardened to obtain good wearing surfaces. When carburizing is specified for this type it is well to remember it has to be quenched in water which will cause distortion if the design is intricate or has varying cross sections. In such cases it would be better to consider an oil quenching carburizing steel.

So-called "cold rolled" steel is everything to one

person, nothing to another, and considered in its rightful place by others. As it is used in the trade today cold rolled is just plain AISI C1020 with a cold-drawn finish and size. Technically, the name or term "cold rolled" is misleading because in modern steel making practice very little steel, other than sheet stock, is cold rolled; it is cold *drawn* through dies and and the term defines the *finish* and *condition* of the material, not the *grade*. Cold-drawn steel is generally available in sizes up to 4¼-in. rounds and occasionally up to 6-in. rounds. Over that size turned and polished stock is furnished when cold-drawn tolerances are desired.

There is nothing magical about the physical properties or use of cold-drawn steel. Its physical properties are slightly better than hot-rolled 1020, TABLE II,

TABLE II

Comparative Properties of Cold-Drawn & Hot-Rolled AISI C 1020

	Tensile Strength (psi)	Yield Point (psi)	Hardness (Brinell)
Hot Rolled	65,000	40,000	128
Cold Drawn	70,000	60,000	146

due to the cold drawing operation which breaks up the normal grain structure (of course the turned and polished stock, not being cold drawn, has the physical properties of hot rolled 1020). It should be used on parts where AISI C1020 is satisfactory and where a cold-drawn finish and tolerance is desired. Odd shapes such as hexagon sizes are more often than not cold drawn both because of manufacturing expediency and because parts made from them are often run through automatics and screw machines. If much machining is necessary cold worked material will distort considerably due to strains induced by the cold drawing. It will also tend to distort more than hot-rolled 1020 in carburizing. Therefore, if much machining is involved it is better to use AISI C1020 hot rolled rather than cold drawn.

Definite Specifications Needed

"Machine steel" or "machinery steel" is another much abused term and seems to be quite a catch-all specification on drawings. To the average designer this generally means a steel in about the AISI C1020 class although some people consider it to be anything from AISI C1010 up (including C1045). This is a point the designer would do well to keep in mind: Always specify a definite steel or steels so there will be no misunderstanding as to what steel has been specifically selected for the job.

ALLOYS (AISI A2315-20, A4615-20, A8620, etc.): When parts such as gears, pins, shafts, etc., have to be tough, withstand extreme shock, and at the same time possess long wearing qualities, these steels are generally used in the case-hardened condition. Also, being of the oil quenching variety, they distort less than the water hardening, plain-carbon carburizing steels. The steels in this group vary in alloy content and those more highly alloyed than others develop higher physical properties, but at the same time cost more. An example of a part requiring the physical properties of a steel in this group is the feed drive worm for a heavy-duty milling machine shown in *Fig.* 2. The worm requires a hard wear-resistant case, high core strength and toughness, and low distortion. It was machined from a 5¼-inch diameter hot-rolled bar of AISI A4615, nickel-molybdenum type steel. A case with a depth of about 0.062-inch and a hardness of about 62 Rockwell C was developed with the following treatment: Carburized 8 hours at 1675 F, cooled in pot, reheated to 1525 F, quenched in oil, tempered (drawn) 2 hours at 350 F.

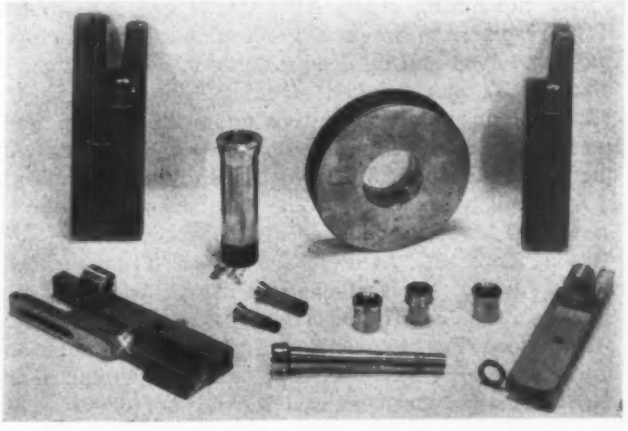
Another application for these steels, and those with a little higher carbon content (up to 0.30 per cent), is on parts, such as studs, that are subject to an unusual amount of fatigue (such as severe reverse bending) and shock in service. The higher carbon alloys can stand this action up to a certain point and then often fail, but these low-carbon alloys when given a standard toughening heat treatment (quenched in oil) seem to withstand fatigue failures as well as or better than other type steels.

Medium Carbon Steels

Medium carbon steels are those in the 0.35 to 0.55 per cent carbon range with the most widely used being from 0.40 to 0.50 per cent carbon. Here, as in the low-carbon group, it is the alloy content that is the principal factor governing the price of the material. The higher a steel in carbon content, other factors being equal, the higher the hardness that can be developed. At the same time, however, the toughness decreases with increased hardness. Conversely, the lower the carbon, other factors being equal, the lower the hardening ability, but the greater the toughness (resistance to shock) of the steel. These medium-carbon steels are to a great extent intended to develop the most satisfactory combination of hardness and toughness ror a wide variety of jobs.

PLAIN CARBON AND SEMIALLOYS (AISI C1045, C1137, A1335, etc.): These steels are used when better physical properties are required than obtainable with the plain low-carbon grades, particularly in regard to tensile, yield and torsional strength. They

Fig. 5—Group of parts made from water hardening steels to provide maximum case hardness and core toughness



are often used untreated or in the annealed or normalized condition where service stresses are not severe. Another similar type of application is for parts where size and weight are sufficiently large to insure adequate required physical properties. An example of this might be on a power shovel shaft; it is obvious that such a machine has to be designed so as to have sufficient weight properly placed to counterbalance the loads picked up by the dipper. The relative low cost of these steels often makes it economical for the shaft to serve a double purpose—to transmit power and act as counterweight. For instance, if the shaft had to withstand a tensile pull of 160,000 pounds a bar of AISI C1045 with 2 square inches cross sectional area could be used instead of a smaller shaft heat treated to develop the necessary strength, since the tensile strength of that steel is about 85,000 psi in the "as-rolled" or "natural" condition. For medium-duty shafts, axles, pins, studs, spindles, etc., these steels can be heat treated if necessary.

AISI C1045 usually has to be softened by annealing if much machining is necessary. It is also a water quenching steel which is satisfactory on many heat treated parts. However, on parts which have heavy and thin sections, the chance of distortion is considerable and if such is not desired or acceptable the designer should plan on using one of the oil hardening grades.

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Free machining steels AISI C1137 and A1335 are often resorted to when a great amount of machining is involved and on deep drilling and deep slotting jobs. C1137 can be heat treated by quenching in either oil or water depending upon the section and hardness desired. For instance, a 1-inch section will quench out to about 363 Brinell with oil and to about 415 Brinell with water. The effectiveness of both the oil and water quenches drops as the size of the section increases. AISI A1335 is an oil quenching steel. Cost of these steels is a little more than for C1045, but often circumstances justify their use.

The steels in this group can be flame or induction hardened to obtain hard, long wearing surfaces on parts such as gear teeth and bearing surfaces.

MEDIUM ALLOYS (AISI A3140-50, A4140-50, etc.): Steels in this group are best adapted and most widely used for heavy-duty shafts, gears, axles and studs which must withstand heavy loads, shocks, bending and the like. Heat treatment is necessary to ensure most economical use. Generally speaking, these steels are used on parts at hardnesses below 50 Rockwell C. Being oil hardening they distort less than the carbon water hardening steels and are better adapted for intricate parts. As noted in the machinability table it is with varying degrees of success that they can be machined after being heat treated to the lower hardness or toughness ranges (about 225 to 321 Brinell). Thus, it is often possible to eliminate more expensive grinding operations that might otherwise be necessary if the parts were heat treated after machining. *Fig.* 3 shows some heavy-duty gears and pinions made from an AISI A4145, chromium-molybdenum type steel that are used at about 50 Rockwell C hardness. The gears were finished machined all over from hot-rolled annealed bar, oil quenched from 1500 F, drawn, and finally finish ground. Selection was based on the necessity for maximum combination of hardness, strength and toughness, minimum distortion, uniform response to heat treatment, and good machinability.

As mentioned earlier in the foregoing there are some resulphurized steels on the market that are more readily machinable than similar standard grades. This is of particular interest to those making production parts and parts to be used at 311 to 360 Brinell where it might be expensive or difficult to heat treat after machining and hold grinding tolerances. *Fig.* 4 shows a worm for a truck winch made from a resulphurized 0.50 carbon-manganese-chromium-molybdenum alloy steel. Four-inch diameter bar stock was cut to length and quenched in oil from 1525 F, drawn at 950 F to a hardness of about 38 Rockwell C, machined all over, and finish ground to final dimensions.

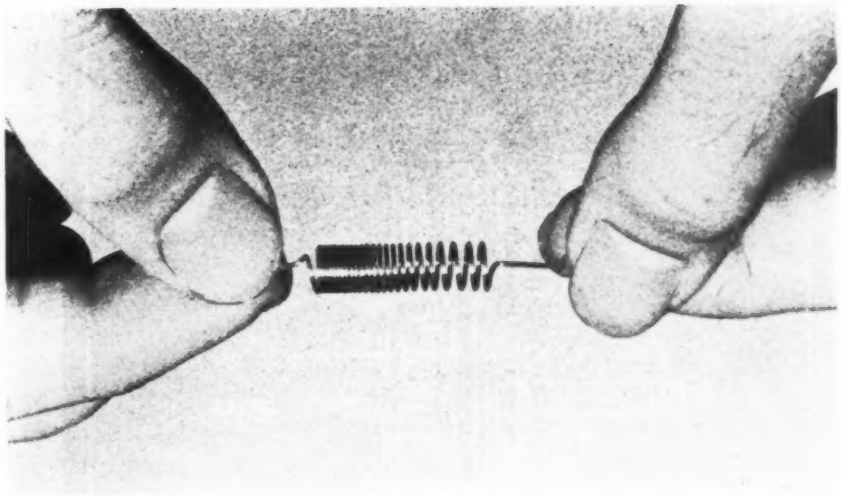
The usual method of heat treating referred to here is the standard oil quench and draw which is more universally used and more simple to use than most other procedures. The 0.35 to 0.45-carbon steels in this group can also be flame or induction hardened to obtain a long wearing (58 to 63 Rockwell C) surface with a tough, previously heat treated core if desired.

RICH ALLOYS (AISI A4340, A3250, etc.): Response to heat treatment by oil quenching, especially in massive sections, and splendid resistance to shock in the heat treated condition characterize the steels in this group. These steels are used for much the same type parts as those in the medium-alloy group, but where greatest possible strength is required. In the lower hardness ranges (under 321 Brinell) in smaller sections (under 3-in. diameter) there is no marked difference in physicals between this and the medium-alloy group. It is in the higher hardness ranges and also in the larger sections when heat treated that this group shows up to best advantage. (They also cost more).

In designing large shafts, for instance 8-inch diameter by 10 feet long, the designer frequently specifies AISI C1045 feeling that in large sizes the effect

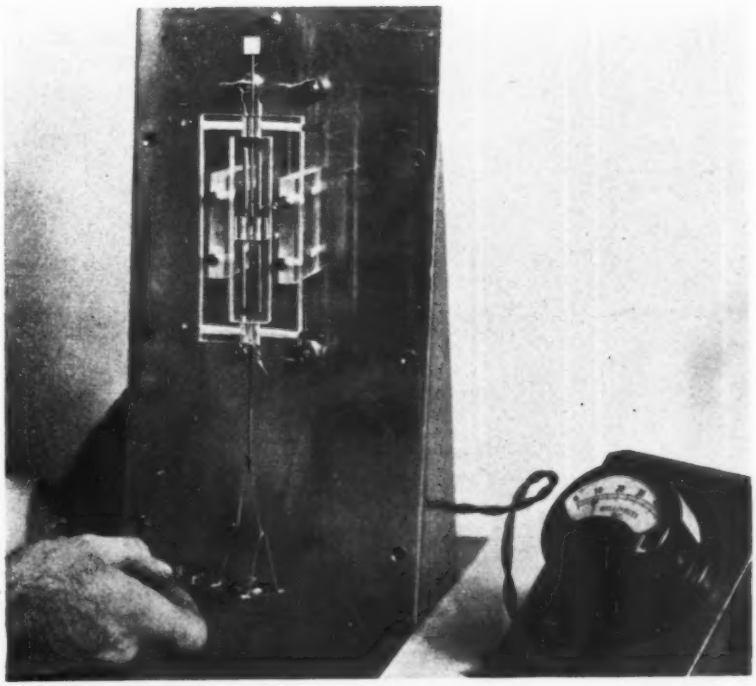
(*Continued on Page* 152)

Scanning THE FIELD for Ideas



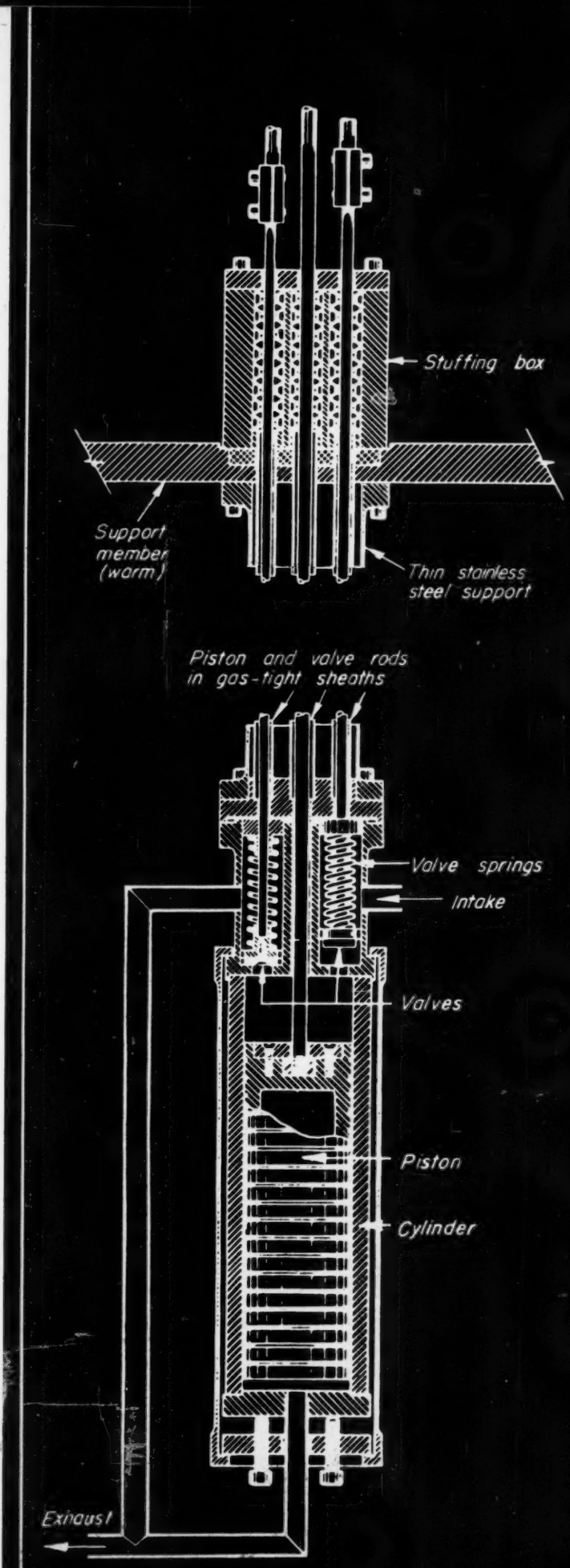
Variable-resistance spring transducer, below, being developed at the National Bureau of Standards, transforms slight displacement into large changes of resistance, current or voltage. The active element of the device is a helical spring, right, wound in such a way that the initial tension varies slightly along its length. Thus, when the ends of the spring are pulled apart, the coils separate one by one rather than simultaneously.

When the spring is entirely closed, it has an electrical resistance approximately that of a cylindrical tube. When completely open, its resistance is that of the total length of the coiled wire. As the coils are pulled apart the percentage change in resistance may be hundreds of times greater than that of the change in length, displacements as small as 0.00001-inch being readily measured without the aid of electrical amplifying devices.



Construction of the transducer is in the form of a four-arm bridge of which each arm is a variable-resistance spring. These springs are mounted so that an increase in applied tension elongates one pair of springs and shortens the other pair, unbalancing the Wheatstone bridge circuit. Measure of the displacement is indicated by a galvanometer.

Initial tension of the spring is varied along its length by either varying the feed of the wire on a uniform mandrel or by varying the tension on the wire as it is wound. For sensitivity this variation

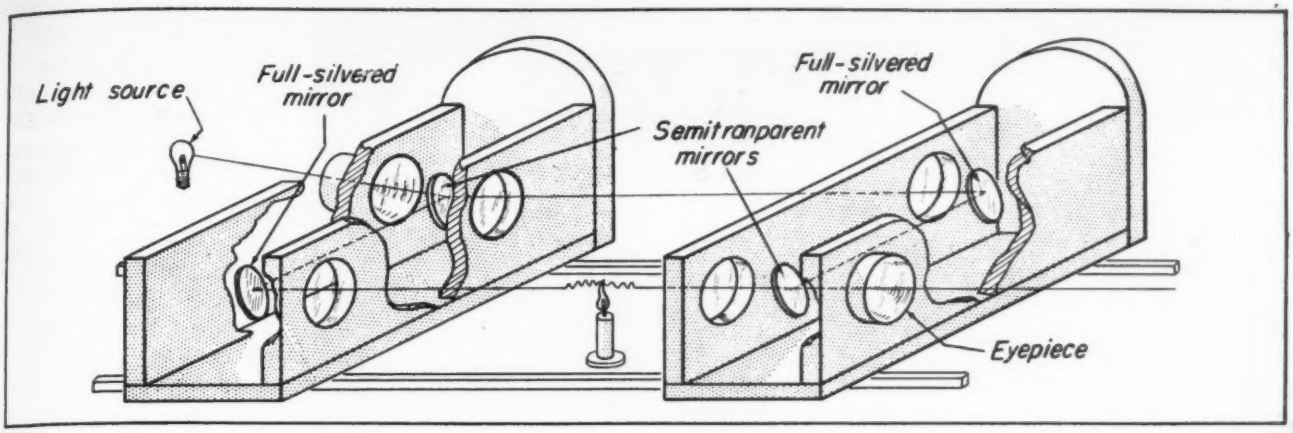


is made small. To decrease contact resistance between successive coils of the closed spring, a high average initial tension is built into the spring and the turns are coated with 0.0001-inch of gold. Wire for the spring is nickel alloy because of its high resistivity and small change in mechanical properties with temperature.

Operation without lubricants is essential in the engine shown at left because of the extremely low temperatures at which it operates. Called a Collins helium cryostat, manufactured by Arthur D. Little, Inc., this engine can, for example, cool pure helium from 22 to 12 degrees Kelvin while expanding the gas from 195 to 1 psi. All known lubricants are solid at this temperature range (−420 to −438 F). For this reason, it is necessary to operate the piston absolutely dry. Also to avoid loss of refrigerative effect, it is necessary to hold friction to a minimum between cylinder and piston.

Nitrided Nitralloy is used for both the piston and the cylinder, finished to very close tolerances and to a high surface finish. The well-known principle of grooving the piston is used to prevent sidewise thrusts due to unequal gas pressures around the periphery. In addition, the piston is driven in a free-floating manner to allow sidewise motion in the joint between it and its rod.

To prevent excessive transfer of heat from the warm engine mounting to the cold piston and cylinder, long slender stainless steel supports are employed. Low thermal conductivity of stainless steel combined with a minimum of cross section of support and unusual length result in low loss of refrigerative effect. Similarly, slender stainless steel valve and piston rods provide a good thermal barrier. In order that these rods may operate without distortion and consequent binding on the unlubricated gas-tight sheathes which surround them, they are held in tension at all times. The piston is single acting so that gas pressure always tends to apply tension to the rod. Valves are closed by heavy springs so that their rods are also in tension.



Flame temperatures in rockets and jet-propulsion engines are measured with the aid of the optical interferometer shown schematically above. Designed by Allis-Chalmers for use in the U. S. Navy Research Laboratory at the University of Wisconsin, the instrument differs from other laboratory units both because of its 9-inch size and its housing which provides distance adjustability.

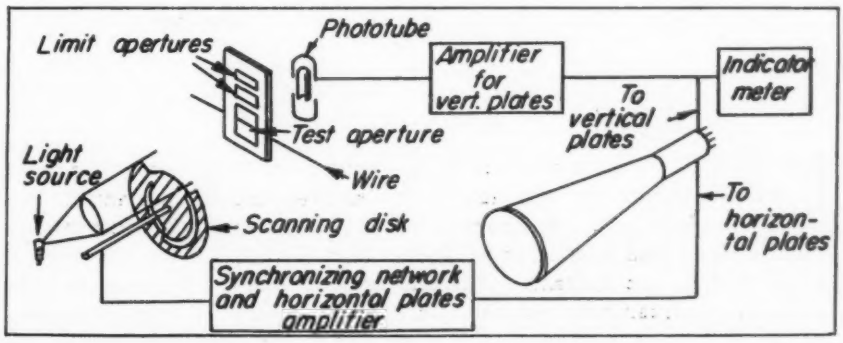
As shown in the sketch, light enters the first housing where half the beam is reflected from a semitransparent mirror and half is transmitted through to the second housing. The reflected beam is directed through the flame being studied while the transmitted beam is bypassed around the flame. The semitransparent mirrors have aluminum surfaces, one molecule thick. A system of mirrors joins the two beams at an eyepiece in the second housing. Difference in their phase, caused by half the light passing through the flame, is observable as light bands showing temperature configuration.

Accuracy of the unit is improved by housing it in a gastight chamber to regulate the pressure of the air surrounding the optical system. The two housings are mounted on a set of parallel rails to allow setting of the distance between them. Interior mirrors are positioned by outside controls.

Accurate measurement of materials during the process of production is obtainable with an electronic micrometer using the circuit shown schematically. Because the device is so arranged as to compare the material being measured with tolerance limits, accuracy is not affected by characteristics of the circuit or changes in line voltage. Developed by Raymond M. Wilmotte Inc., the instrument measures the outside diameter of wire, thread, tubing, rod, and strip within an accuracy of ±0.0001-inch without contacting the material being processed. As indicated in the sketch, light is transmitted, in sequence, through two limit and one test apertures. The object being measured casts a shadow, thereby reducing the illumination of the cathode of a phototube located behind the apertures. Representing the positive and negative tolerances for measurement, the two limit apertures provide reference voltages for comparison with that from the test aperture.

To obtain these voltages in sequence, a scanning disk directs the light to each aperture in turn. The voltages, synchronized with the disk rotation, are amplified in a common amplifier circuit and then applied to the vertical deflection plates of an oscilloscope. Sweep voltage is applied to the horizontal plates of the oscilloscope in such a manner that termination of each viewing cycle occurs at the same time that the scanning disk alternates from one aperture to another.

In this system sensitivity is not dependent upon the size of the object being measured, the deflection obtainable for any given deviation in size being the same. Indications appear as three horizontal lines on the face of the oscilloscope due to the persistence of the screen combined with a rapid scanning rate. Change in size of material causes the test trace to change its position relative to the two limit traces. Automatic control for processing may be added to the circuit.



Final design for the Sec Cleaning Systems' automatic dry cleaning machine evolved as a result of a predesign research program, the steps of which are illustrated graphically on the following pages

Predesign Research

. . . its relationship to design, engineering, production, and sales

By Roger L. Nowland

Partner
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New York

TODAY, the manufacturer is no longer in a position where he can afford to assume that his product will be accepted merely because he has always had a good reputation. Nor can he depend entirely on intensive advertising and merchandising to guarantee success. In order to compete successfully in a highly competitive market, a manufacturer must have a product which meets the consumers' demands *better* than any other product of its type, and which can be sold at a price the consumer is willing to pay. These conditions must be met at a time when material and labor costs are at

peak levels and when manufacturers do not have either the time or money to invest in developing products for which there may not be an assured market. The problem is then—What is the consumer looking for in a product such as mine? How much is he willing to pay for it? Can it be produced at a cost which permits a reasonable profit?

Engineering and production departments are generally in a position to provide the answer to production costs; however, unless they are provided with a clear statement of what the consumer wants, they cannot proceed with any assurance that even a technically improved product will meet with consumer acceptance. The answer to this problem can come from only one place—the person who buys and uses the product.

Alert manufacturers have long recognized the importance and value of maintaining close contact with their markets. They have utilized research to secure information from distributors and consumers which would assist them in developing sales, advertising and marketing plans. However, in general, the emphasis is on merchandising research—surveys on brand preferences, advertising effectiveness, study of channels of distribution, sales potentials—the kind of research that is undertaken usually *after* product development, not before it. It has been our experience that too few manufacturers use research as a tool for setting up specific guides, based on known facts, to aid the engineering and production departments in their work.

When is pre-design research necessary?

When a manufacturer has any indication that he is not getting his proper share of the market, the conditions are undoubtedly such that predesign research is necessary. It is possible that his product is not receiving favorable consumer acceptance in comparison with competition, that his advertising and sales promotional material is not properly directed to his consumers, or that his brand name has lost standing for some reason unknown to him. It is at such times that predesign research should be utilized as a tool to determine where the troubles lie and to learn, in the course of this work, what is necessary to correct the situation. The question of whether a manufacturer should hire outside organizations to conduct predesign research or whether he should rely on his own organization is often raised. Serious

1. INDEPENDENT ANALYSIS

OPERATING EFFICIENCY

	SEC-O-MATIC	MACHINE A	MACHINE B	MACHINE C	MACHINE D
TIME OF CLEANING CYCLE IN MACHINE	12 MIN. WASH & EXTRACT	32 MIN. WASH, EXTRACT & DEODORIZE	25 MIN. WASH, EXTRACT & DEODORIZE	35 MIN. WASH, EXTRACT & DEODORIZE	12 MIN. WASH & EXTRACT
CAPACITY (PER CYCLE / PER HOUR)	15 LBS. 75 LBS.	27 LBS. 50 LBS.	20 LBS. 48 LBS.	22 LBS. 42 LBS.	10 LBS. 50 LBS.
TOTAL COST OF CLEANING PER LB. OF GARMENT *(Claimed)*	1.7¢	1.0¢	3.0¢	2.5¢	2.7¢
SOLVENT COST PER LB. OF CLEANING *(Claimed)*	1.4¢	0.6¢	2.5¢	2.0¢	2.4¢
EQUIPMENT COST PER LB. HOURLY CAPACITY	$3000 / 75 LBS. = $40.00	$3600 / 50 LBS. = $72.00	$4000 / 48 LBS. = $83.00	$6678 / 42 LBS. = $159.00	$2195 / 50 LBS. = $44.00
FLOOR SPACE USED PER LB. HOURLY CAPACITY	49½ SQ. FT. / 75 LBS. = .66 SQ. FT.	44 SQ. FT. / 50 LBS. = .88 SQ. FT.	36 SQ. FT. / 48 LBS. = .75 SQ. FT.	54 SQ. FT. / 42 LBS. = 1.3 SQ. FT.	27 SQ. FT. / 50 LBS. = .54 SQ. FT.

2. INDEPENDENT ANALYSIS

DEGREE OF AUTOMATIC OPERATION

	SEC-O-MATIC	MACHINE A	MACHINE B	MACHINE C	MACHINE D
WASHING SOAP WASH SOLVENT RINSE EXTRACTION DEODORIZATION	★ LOAD BASKET SET CONTROL NO PROVISION ★ UNLOAD BASKET, HANG GARMENTS IN CABINET FOR DEODORIZATION ★ REMOVE FROM RACKS	★ LOAD BASKET SET CONTROL ★ ADD SOAP AND RESET CONTROL OPTIONAL ★ UNLOAD BASKET	★ LOAD BASKET SET CONTROL NO PROVISION ★ RESET CONTROL ★ RESET CONTROL ★ UNLOAD BASKET	★ LOAD BASKET SET CONTROL ★ ADD SOAP AND RESET CONTROL OPTIONAL ★ RESET CONTROL ★ RESET CONTROL ★ RESET CONTROL ★ UNLOAD BASKET	★ LOAD BASKET SET CONTROL NO PROVISION ★ CHANGE POSITION OF BASKET AND RESET CONTROL ★ UNLOAD BASKET, HANG GARMENTS IN CABINET FOR DEODORIZATION ★ REMOVE FROM RACKS
TOTAL TIME REQUIRED FOR COMPLETE CYCLE	17 MIN.	32 MIN.	25 MIN.	35 MIN.	17 MIN.
TYPE OF CONTROL	"VARITROL" MULTIPLE SPRING TIMER SOME ELECTRIC VALVES	"FORMATROL" ELECTRIC TIMER ELECTRO-PNEUMATIC VALVES	SPRING TIMER HAND OPERATED VALVES	CIRCULAR MASTER CONTROL HAND OPERATED	SPRING TIMER HAND OPERATED VALVES
FILTRATION	CONTINUOUS AUTOMATIC	CONTINUOUS AUTOMATIC	CONTINUOUS AUTOMATIC	CONTINUOUS AUTOMATIC	CONTINUOUS AUTOMATIC
FILTER POWDER	INJECTED AUTOMATICALLY	PUT IN WASHER BY HAND	PUT IN WASHER BY HAND	PUT IN WASHER BY HAND	PUT IN WASHER BY HAND

consideration should be given this problem.

There is little doubt that the use of outside organizations offers marked advantages. Very often there is indecision in new product planning and this indecision is aggravated by the various differences of opinion and prejudices that frequently exist between different departments and individuals in the manufacturer's own organization. Many times sales departments and production departments look at new products in entirely different lights, and a manufacturer's organization may be restricted by habit and past prejudices that no longer need exist.

The outside organization, on the other hand, is able to approach the problem objectively and arrive at solutions that derive solely from factual information. The outside organization is divorced from the distractions and limitations that often "hog-tie" those who are too close to the problem and are, in a sense, specialists who can offer a wide variety of experience in solving comparable design problems.

One of the principal objectives of predesign research is to provide the engineering and production departments with design specifications, pretested as to consumer needs and preferences, before time and money are spent in developing the product. It also supplies the sales and advertising departments with valuable information about the market and consumer wants.

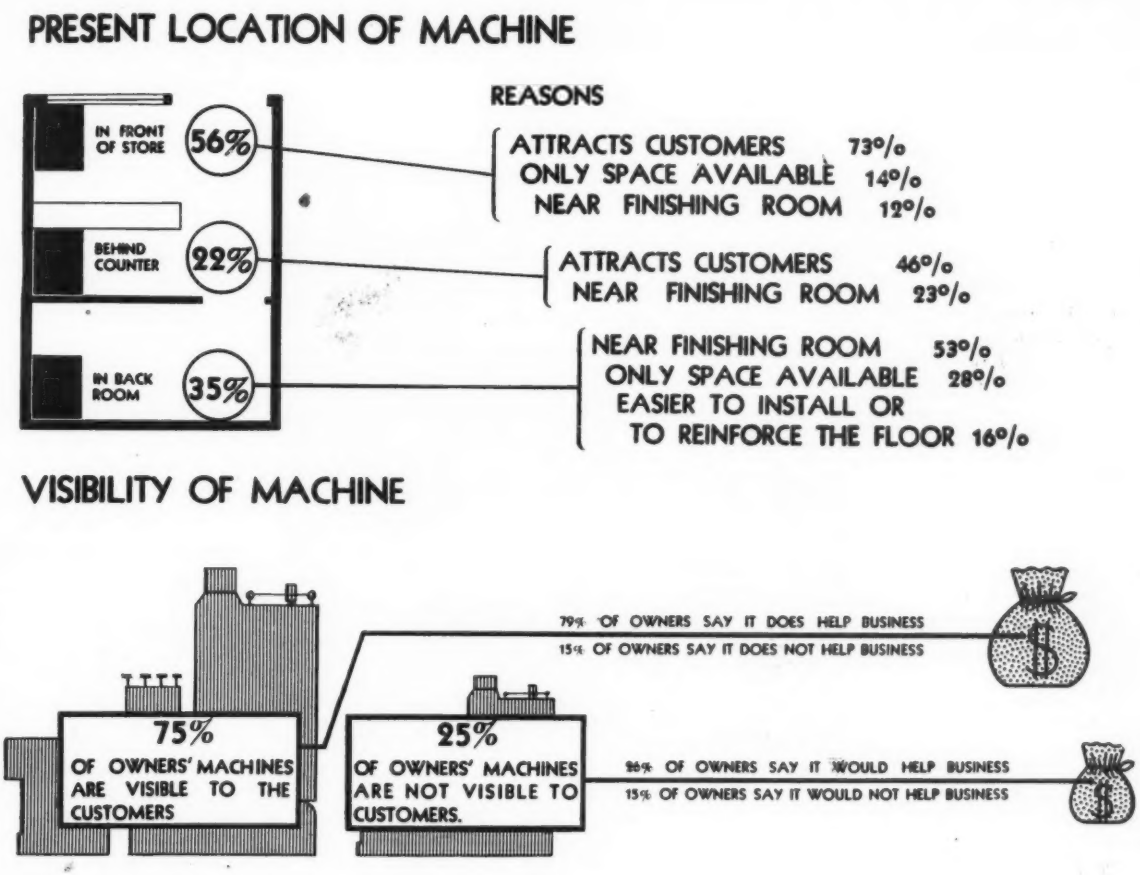
What Is Predesign Research?

Predesign research is a scientific method of establishing guideposts, based on facts, for the direction of all departments concerned in placing a product on the market. Actually, predesign research is a combination of several analyses and research operations which are co-ordinated in such a manner that a complete picture of market requirements such as product characteristics, acceptability, methods of promotion, packaging and related factors is revealed. It consists of objective, logical analysis combined with careful, intensive field investigation among properly selected respondents for the purpose of obtaining answers to questions which are of basic importance in any product development or sales program.

Techniques of Predesign Research

Although the techniques will and should differ for each specific problem, the basic factors in any

3. FIELD SURVEY



predesign research remain the same. It is generally recognized that once a problem has been clearly stated, it is 75 per cent solved. At the outset of any predesign research program, it is vital that the concept of the problem and the statement of the purpose of the program is fully comprehended and agreed upon by all parties concerned.

INDEPENDENT ANALYSIS: The first step in predesign research is to turn the problem over to a *qualified person with a completely objective attitude* to determine ideal specifications for the product. The person in charge of this phase approaches the problem completely unhindered by any practical considerations. His only problem is to study the conditions under which the product will be used, the manner in which it will be used and the job the user expects it to do.

This objective analysis can best be compared to the development of a geometry theorem wherein certain axioms of user habits and the application of logical thinking can develop concrete conclusions. By this process, a set of specifications which define a functionally ideal product is developed without regard to whether or not production of this product is feasible from the standpoint of cost or manufacturing.

FIELD RESEARCH: The techniques of field research are used in order to determine actual consumer preferences, the competitive position of the product and the reaction of consumers to new ideas and changes. This phase of predesign research can be carried on concurrently with, but is entirely separate from, the independent analysis.

Interviewing for predesign research cannot follow the question and answer method ordinarily used in opinion polling. It is necessary to conduct interviews on a conversational plane wherein a feeling of confidence and a feeling of common purpose with the respondent are definitely established. The interviews must be sufficiently searching to bring out all possible information that may be partly formed or uncrystallized in the minds of the respondents as well as the more objective and immediate criticisms which he is sure to have. The information the interviewer desires is not statistical in character but rather is a history of the respondent's experience with a product from which may be gleaned indications as to how that product might be improved.

The tabulation and evaluation of this type of interview points out the general attitude toward the product in question, the specific features which are

4. FINAL ANALYSIS

DEODORIZING

SHOULD

REQUIRE A MINIMUM MANUAL EFFORT

NOT EXPOSE OPERATOR TO FUMES

GAUGES

SHOULD

BE CENTRALIZED

NOT COLLECT DIRT

HAVE GOOD VISIBILITY

DISTILLATION

SHOULD

BE CONTROLLED

BE AUTOMATIC

HAVE MAXIMUM EFFICIENCY

REQUIRE MINIMUM ATTENTION

WASHER

SHOULD HAVE

CONTROLLED AGITATION

COMPLETE SUBMERSION

CONTINUOUS CIRCULATION OF FILTERED SOLVENT

INCREASED WASHING CAPACITY

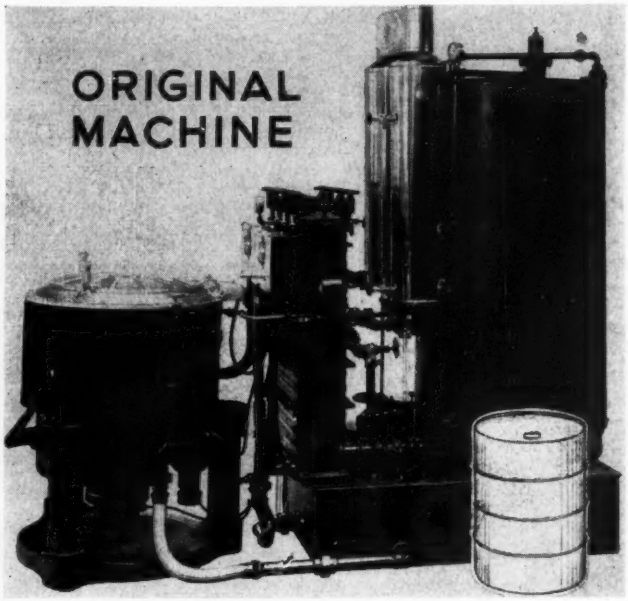
FLEXIBILITY FOR ALL TYPES OF GARMENTS

PROVISION FOR SOAP

EASY LOADING AND UNLOADING

MINIMUM PRACTICAL EXTRACTION SPEED

FREEDOM FROM EFFECTS OF WATER



FILTER

SHOULD

HAVE MAXIMUM EFFICIENCY

NOT REQUIRE FILTER POWDER

OFFER EASE OF CLEANING

SOLVENT

SHOULD BE

RECLAIMED WITHIN LIMITS OF ECONOMY

CONVENIENTLY STORED AND ADDED TO MACHINE

CONTROLS

SHOULD

BE CENTRALIZED

NOT COLLECT DIRT

BE A MINIMUM NUMBER

GENERAL

THE MACHINE SHOULD OFFER

CAPACITY SUITABLE FOR MAJORITY OF USERS

CLEANING CYCLE REQUIRING MINIMUM OF TIME

MINIMUM OPERATING COST

PROVISION FOR SPECIAL FINISHES

MINIMUM OPERATING REQUIREMENTS

STRONG CONSTRUCTION OF ALL COMPONENTS

MINIMUM DIMENSIONS AND WEIGHT

MINIMUM VIBRATION

MINIMUM SPACE REQUIREMENTS

NEUTRAL COLOR

CUSTOMER SALES APPEAL

DISTINCTIVE APPEARANCE

VALVES

SHOULD BE

CENTRALIZED

ACCESSIBLE

SERVICING

SHOULD

PERMIT EASY ACCESS TO ALL PARTS

REQUIRE A MINIMUM OF FREE STANDING SIDES

REQUIRE A MINIMUM OF ATTENTION

unsatisfactory and those which are acceptable to consumers. Unfortunately, this is not enough information on which to base design specifications.

For instance, the statement may be made that the top speed on a certain machine tool is too slow. If this is accepted as a fact, it might lead to an increase in the speed on a new model with greatly increased engineering problems and manufacturing costs. However, further analysis and investigation may lead to the discovery that the reason for the statement was that the user did not properly operate the machine, indicating that the controls were not properly arranged or correctly interlocked. This would lead to an entirely different solution to the design problem, without necessitating any increase in the speed of the machine.

FINAL ANALYSIS: The final phase of predesign research is to combine the results of the independent analysis and the field research in order to achieve a balance between the theoretical and practical objectives. The proper combination of these two sets of data results in ideal specifications and recommendations.

After the ideal specifications have been defined, they are studied and refined in terms of cost, manufacturing requirements, trade standards and practices, and patent aspects. The final specifications, as modified, are then reviewed with respect to trends which may have an important bearing on the future course of the product.

By using such a logical system of arriving objectively at the facts, a theoreticaly perfect product—within practical limitations—can be developed at a fraction of the cost of setting up a pilot operation and embarking on an expensive promotional campaign. The following case histories are a few examples of how predesign research has proved profitable to far-sighted manufacturers.

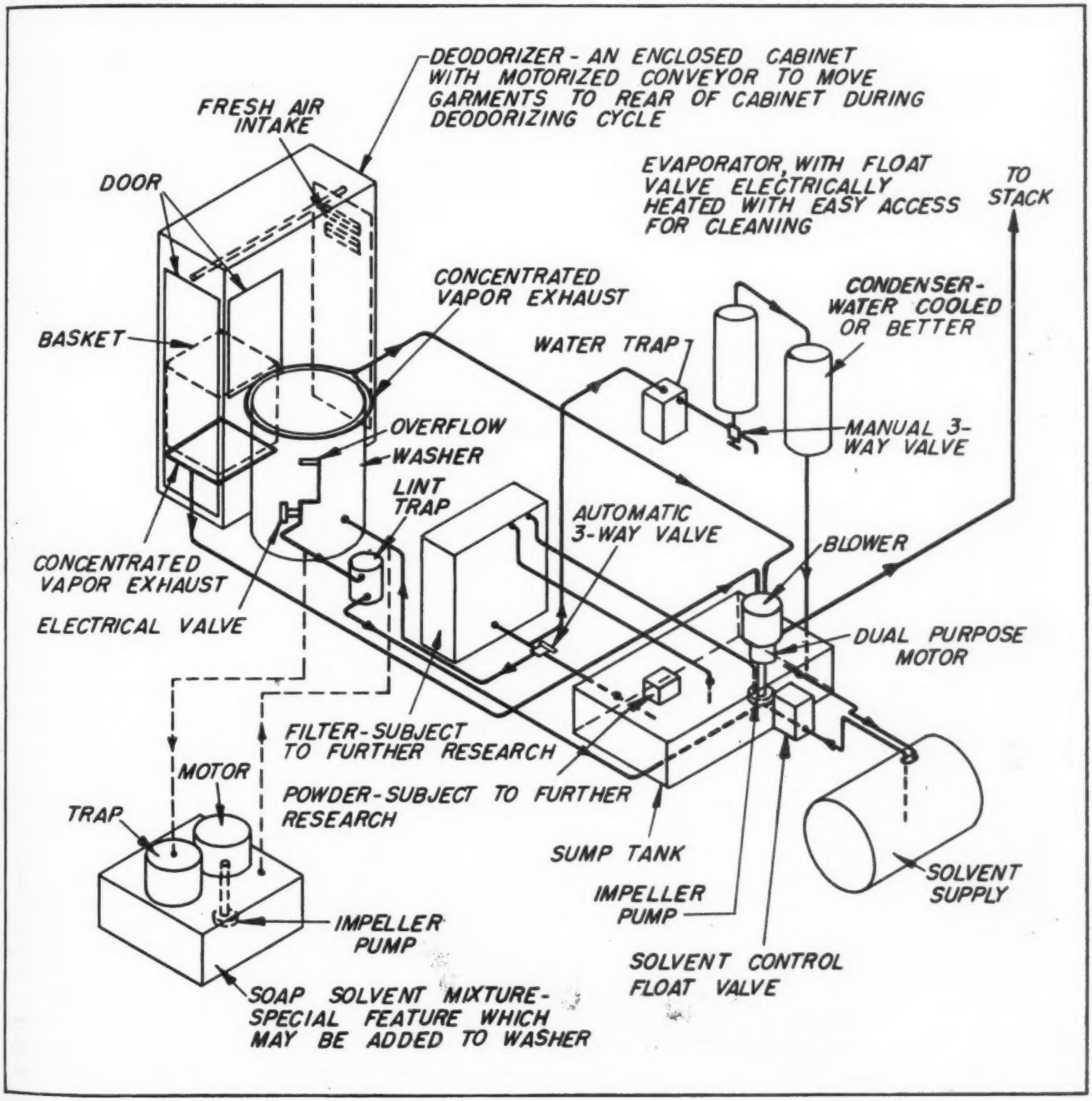
The manufacturer of a specialized machine tool, widely used by a particular industry, believed that his machine met the requirements of his customers in every respect as to accuracy, cost, degree of automatic operation, and ruggedness. However, he felt that possible competition might come from a different way of doing the same operation, thereby obtaining a higher output at the expense of greater tooling cost. It was his belief, therefore, that it would be necessary to develop a faster cycle for his machine—a problem which, because of the character of the machine, was an extremely difficult one. In his mind the problem was to determine at what speed the industry would require his machine to operate.

In this case, predesign research established that the manufacturer was misinformed on the feeling of his customers in regard to his machine. It was not sufficiently accurate and was necessitating, because of its inaccuracy, excessive labor costs. Furthermore, the *speed* of the machine was adequate but its rate of output was unsatisfactory due to the slow manual loading.

Automatic loading, a solution materially simpler than increasing the speed of operation, was required. It was also established that the industry would be willing to pay a materially greater price for a more accurate automatic loading machine than they were now paying for the present design. Thus, through the use of proper predesign research, the manufacturer was directed along the proper channel of product improvement which insured his holding the market rather than along one involving radical redesign without market benefits.

A second example concerns a manufacturer producing raw materials, having outstanding merits for use in the furniture industry, who had been unsuccessfully promoting the material to that industry for a number of years. He was convinced that the furniture industry was backward, unprogressive, and unwilling to alter its practices in even a minor degree in spite of the benefits which might accrue to it as a result. A thorough nation-wide predesign study revealed quite the contrary. The furniture industry desired to use the material, was willing to vary its standards over a remarkably wide range to permit the use of the material, but only if in so doing its cost to them could be brought low enough to permit

5. SCHEMATIC OPERATION STUDY



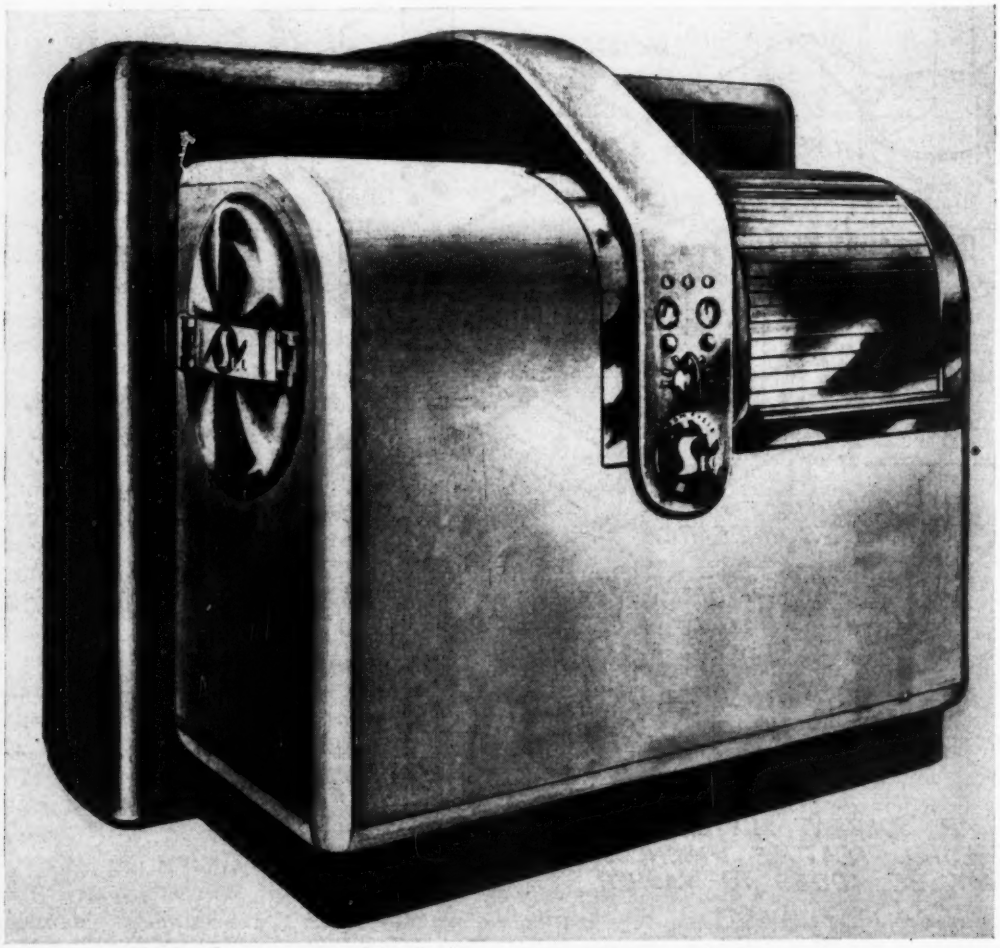
meeting rigid retail price schedules established.

In this case, it was found that the manufacturer had a very co-operative, intelligent industry which recognized the benefits as well as the shortcomings of the manufacturer's product. Contrary to the manufacturer's opinion, the product without some changes was not adaptable to the needs of the furniture industry. Predesign research made it possible for that manufacturer to institute the necessary changes and correct his previous erroneous thinking as to the character of the market he was proposing to sell.

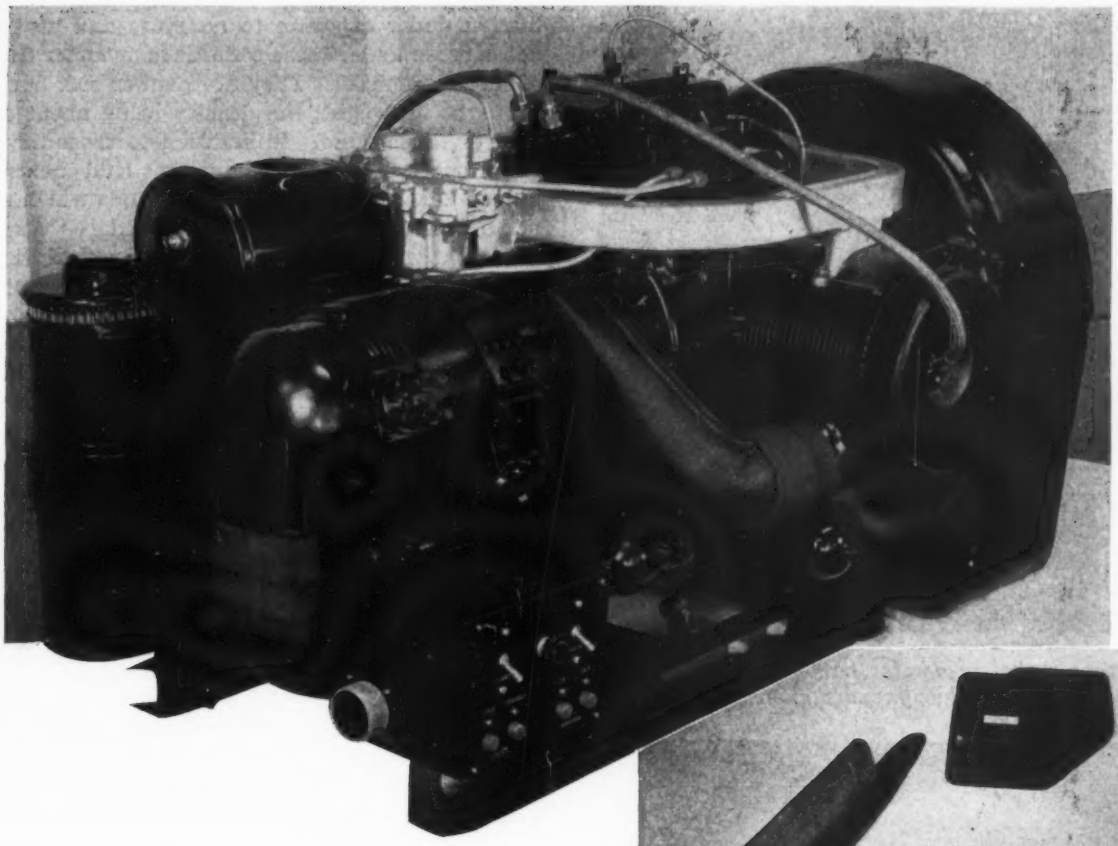
In still another case, the manufacturer of a variety of machines had developed a new processing machine for a particular industry. The satisfactory functioning of this machine for that industry led the manufacturer to the conclusion that the machine could be used generally in a large number of industries. A predesign program investigated the various industries where such a processing machine might be used and established beyond question that in certain of these industries there were definite possibilities provided the character of the machine was changed to meet the particular requirements of these industries. Most important, however, they established that the process with which the machine was concerned was an empirical one and that no machine could be sold to any industry on the basis of its performance in any other industry. It was, therefore, definitely indicated that the selling technique to the new industries must involve laboratory demonstrations of the actual benefits which an industry would obtain through the use of this new processing machine. It also established that in order to properly cover this processing field, the manufacturer would have to enter the market with a number of processing machines, operating on different principles, to provide the tools which industry would expect them to provide, and to warrant the selling costs involved.

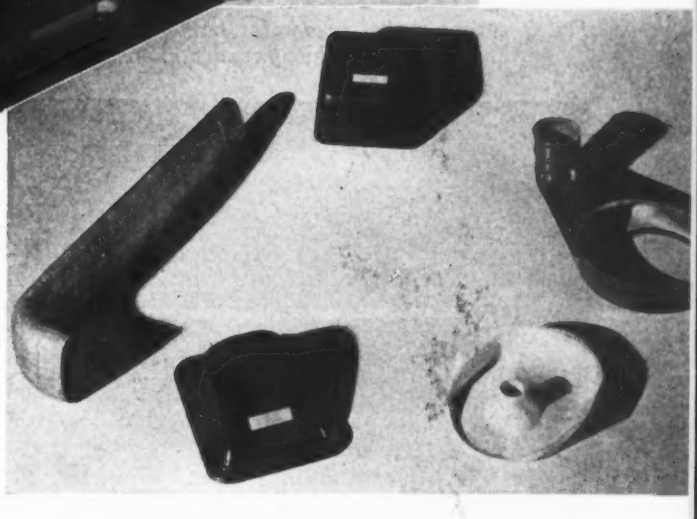
The effective and proper presentation of predesign research deserves the most careful attention. It is unfortunate that much meritorious report work achieves half-hearted acceptance only because of weak and ineffective presentation. Presentations should be so planned that they follow a clear-cut, logical sequence leading directly and smoothly to definite conclusions and recommendations that are made obvious and are in themselves complete. An effective presentation should include graphic illustrations, such as those in the graphical study presented with this article, that offer responsible and busy executives a clear summary and at the same time hold and stimulate their interest.

The value of predesign research has been demonstrated through the development and redesign of many products with outstanding sales success. Today, manufacturers can reduce and even avoid the risk of putting time and money behind a product for which only a limited market exists. The investment of a few dollars in predesign research may save the loss of many dollars later.



6. MACHINE CONCEPTION





Design and Application of Glass-Reinforced Plastic Parts

By Roger White

President
Laminated Plastics Inc.
Cleveland

WHERE relatively small quantities of contoured shapes are required, the designer may do well to consider the glass-reinforced polyester plastics. They can be formed to complicated three-dimensional compound forms without difficulty and with no practical size limitations, yet require no expensive drawing dies for manufacture.

These laminates possess a number of properties of interest and importance to the engineer. For example, they have physical properties in the same range as common metals, TABLE I, and can be used in place of metals in many applications. In addition, they resist cracking or dis-

Fig. 1 — Top — Auxiliary aircraft power unit has air ducts made of glass laminates

Fig. 2 — Above — Glass laminate parts used in aircraft auxiliary power unit. Tubular L-shaped part at left is made by wrapping laminate material around plaster mold.

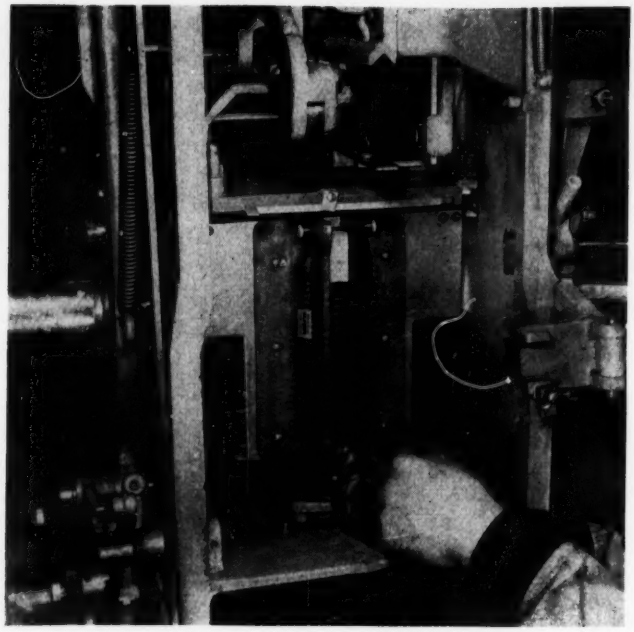


Fig. 3—Above—Label holder for bottle labeling machine has molded-in, threaded inserts

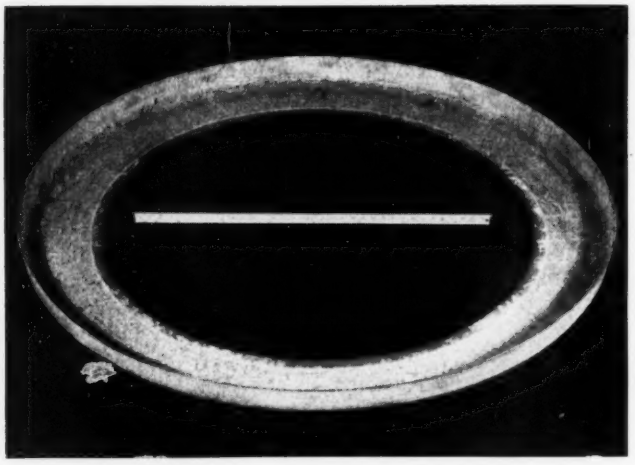


Fig. 4 — Above — Laminated housing for radar antenna measures over four feet in diameter as is graphically illustrated by yard stick lying within the housing ring

Fig. 5—Below—Comparative physical properties of glass laminates and common metals

tortion under exposure to moisture and heat and do not corrode under these conditions or under the action of most chemicals. They are neither soft nor brittle, yet light in weight, the density being about equal to that of magnesium. In addition to these advantageous properties, the glass laminates lend themselves to unique new direct-fabricating methods which serve to make possible involved shapes at reduced cost.

A relative newcomer to the plastics field, this glass laminate is appearing more and more where the qualities described are of value. Example of such an application is the Jack & Heintz auxiliary aircraft power unit, *Fig.* 1, in which the typical polyester laminate, Glastic, is used in five air duct parts. More recent designs employ even greater numbers of glass-laminated parts. All of these components were originally designed for sheet metal construction and all are of complicated shape. In this case the production quantity was not small, being about 500 to 1000 per year; however, the complicated dies required for metal forming would have made the unit price of the parts considerably higher than the maunfacturer considered to be warranted.

Fabricating Methods

Several interesting fabricating techniques used in making these power-unit parts, shown in *Fig.* 2, illustrate the versatility of the laminating process. The generator end cover, seen at the right side of the illustration, was made of two parts formed over hardwood molds and then cemented together. Fabrication of parts of this type is manual. After the fiberglass is saturated in the polyester resin it is laid over the mold in several layers. A vacuum bag is then drawn over the assembled "lay up" to hold it tightly to the form during the oven cure. Assembly of the parts is by means of the same resin, a weld being developed which has almost the strength of the component parts.

The tubular L-shaped duct seen to the left of *Fig.* 2 was formed in a different manner. In this instance, design was such that a wood mold could not have been removed from the cured part. Therefore the mold was made of plaster and after the part was

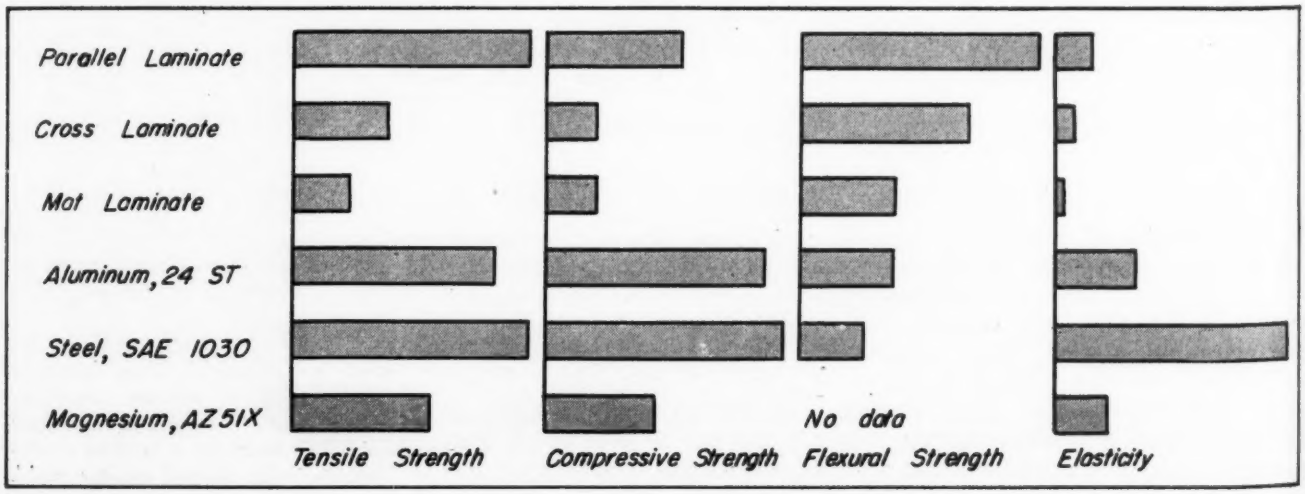


TABLE I—Properties of Glass-Polyester Laminates

Material	Flexural Strength (psi)	Modulus of Elasticity (psi x 10^6)	Izod Impact Strength (ft-lb/in.)	Tensile Strength (psi)	Compressive Strength (psi)	Hardness (Rockwell M)	Specific Gravity	Water Absorption (per cent)	Arc Resistance (seconds)
Parallel Laminates	96,500	4.8	46.0	76,000	42,500	90	1.8	0.26	120
Cross Laminates	38,000	2.2	30.0	30,000	15,000	90	1.6	0.35	...
Mat Laminates	20,500	1.0	21.0	18,000	15,500	90	1.5	0.38	60

cured the plaster was removed by hammering, breaking it into small pieces. The toughness of the glass plastic material allows this hammering without damage to the piece.

The possible intricacy of form together with the physical properties developed have been used to advantage in many other machine parts, an example being the label holder used in a bottle labeling machine, *Fig.* 3. The advantage of being easily fabricated to large sizes is an additional feature that makes laminated plastics suitable for many parts which would be difficult to make from metal and impossible to make by conventional molding practice. There is no limitation imposed by press capacities or oven dimensions. Molds can be made of concrete if desired and the cure heat can be supplied by heat lamps or by steam pipes cast into the mold. The molded Glastic radar-antenna guard ring shown in *Fig.* 4 is over four feet in diameter and much larger shapes have been fabricated successfully by this technique.

PHYSICAL PROPERTIES: As shown in the charts of *Figs.* 5 and 6, the physical properties of the glass laminates compare favorably with common metals of construction. However, modulus of elasticity, while considerably higher than for other plastics, is much lower than that of metals. For this reason special techniques have been developed to increase the stiffness of sections. The sandwich materials are examples of methods of doing this; balsa, cellular plastic or honeycomb material is inserted between two layers of glass laminate to increase the section modulus.

Fig. 6—Physical property-weight ratios of laminates and metals illustrate the advantage of the plastic material's toughness and high tensile strength

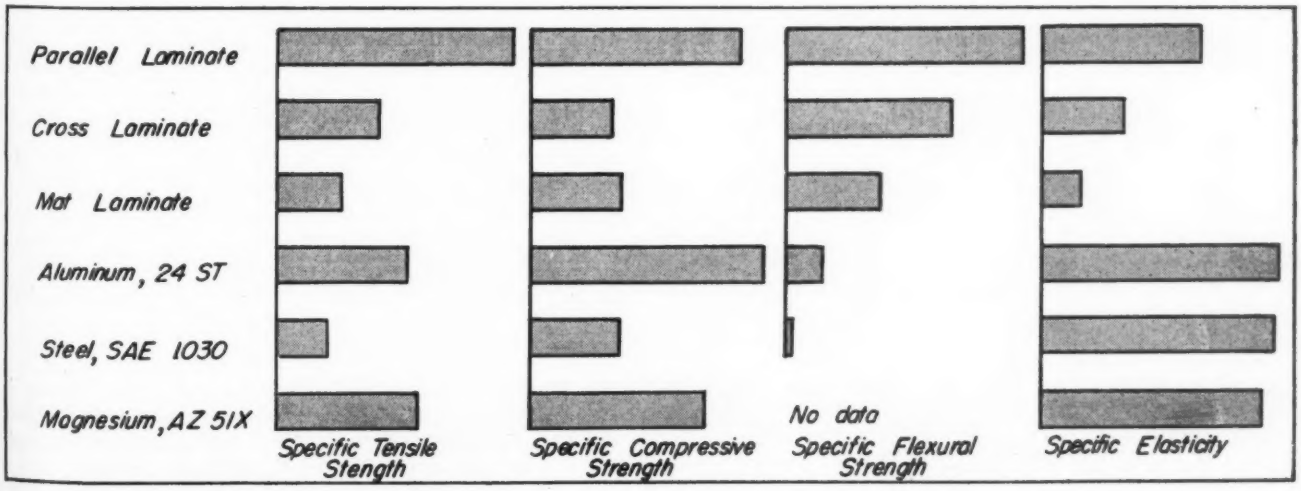
As shown in *Fig.* 6, specific modulus of the laminates, that is the ratio of modulus of elasticity to density, approaches that of common metals, and it is therefore possible to produce rigid assemblies at an actual weight saving.

Given in TABLE I are the typical physical properties of the polyester laminates, illustrating the fact that the material may be selected for strength in compression and tension. Since the direction of glass fibers can be controlled, it is quite feasible to produce parts having principal strength in one, two or three directions by using fabrics of the appropriate weave. It is also possible to produce a material of uniform strength in all directions by using a mat glass rather than a fabric. Uniformity, in this case, is at some sacrifice of maximum strength.

Dimensional Stability Good

Dimensional stability of the material is excellent owing to the high strength of the glass fibers, their low thermal coefficient, and their complete inertness to moisture conditions. Where it is desired to use the material in conjunction with a metal, advantage can be taken of its thermal expansion rate which is approximately equal to that of steel. Expansion joints in large sections can, therefore, usually be obviated and inserts can be expected to remain tight even under conditions of widely fluctuating temperature.

DESIGN: Glass-polyester laminates are basically sheet materials and this fact should be taken into consideration when designing parts to be made of them. Moderate changes in section thickness are possible, but not desirable, and fabricating problems can



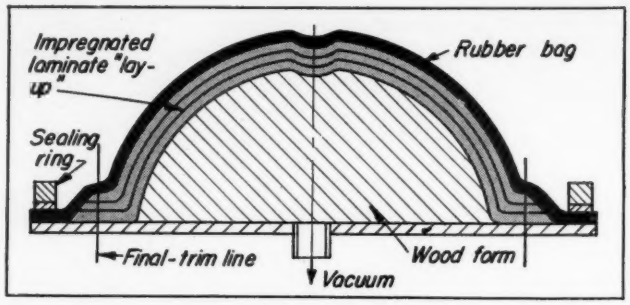


Fig. 7—Left—Vacuum-bag process of molding laminates. Plastic-impregnated cloth is shaped over wood form and then covered by fitted rubber cover sealed to work base. Vacuum drawn under work causes atmosphere to firmly press work against mold

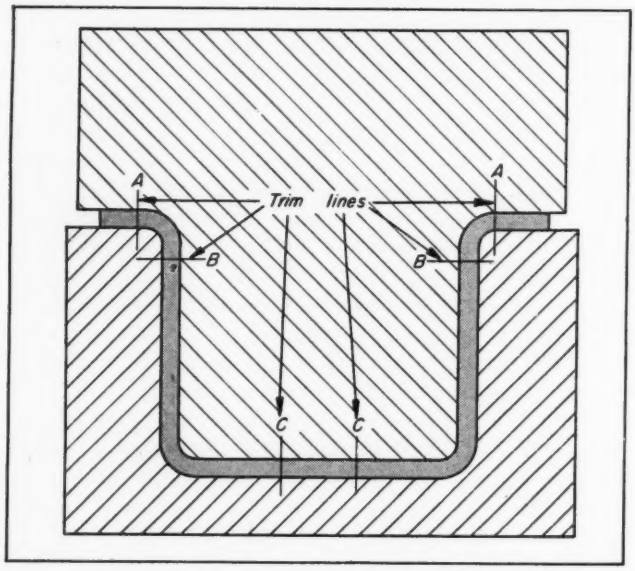


Fig. 8—Above—Open mold process.. Work is confined between two fitting dies.. Flange required for this process can be removed after molding.. A-A, B-B and C-C indicate trim lines of flanged, cylindrical or ported parts

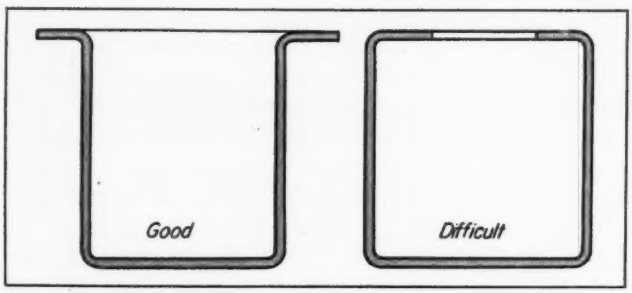


Fig. 9—Above—When flanges are necessary they should be on outside of part to permit easy removal of male mold. Internal flanges require use of fitted, internal, rubber molding bag

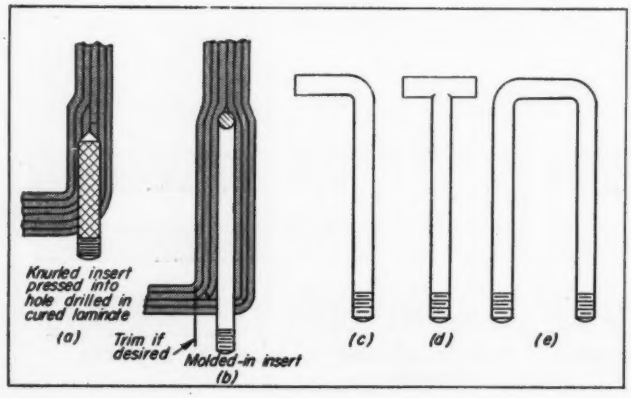


Fig. 10—Left—Inserts may be of the knurled type, pressed into drilled holes after curing (a); or molded-in type (b) for use when high strength is required.. Shown at (c), (d) and (e) are typical designs for molded-in inserts

be viewed almost as those of making drawn metal parts.

Most common method used for manufacturing these relatively short run parts is vacuum bag molding, illustrated in *Fig.* 7. This method requires only a male form with no matching part. Since the polyester resins require no pressure and only modest heat for curing, these forms can be made of wood or plaster. The use of a one-piece mold greatly reduces initial expense since the high cost of matched metal molds is largely a matter of the close tolerance necessary between the two mold members and the means of accurate alignment between them as they close.

The one-piece mold generally requires the use of woven cloth materials which control automatically their own thickness in the vacuum bag. Where larger quantities are required a considerable economy can be realized by using unwoven mat type glass reinforcement. This material generally requires matched metal molds, *Fig.* 8, since it has considerable springiness, or "bulk factor," and must be squeezed under modest pressure to control properly its thickness. In making parts by this method the saturated fabric is laid in the female die and the male is then used to control internal dimensions. Owing to the stretch and limpness of the plastic-wetted glass, it is not possible to fill space precisely and end dimensions are controlled by providing flash and then trimming to size. Typical trim lines are shown in *Fig.* 8, A-A being used for a flanged part, while a simple cylindrical part would be trimmed as shown by lines B-B. In the event that openings were desired in the part, these can best be made by machining after molding; C-C illustrates the location of a hole in the bottom of a part, the original laminate being made with a solid bottom.

Re-entrant Flanges To Be Avoided

Because the male die must be removed after the part hardens, re-entrant flanges should be avoided if at all possible. As shown in *Fig.* 9, better practice would be to provide a simple external flange, which actually must be provided in manufacture in any event. Under certain conditions such re-entrant curves are possible, using an internal rubber bag technique which is just the converse of the vacuum bag method previously described. It uses a female mold instead of a male form and a male bag under pressure in place of an enclosing bag under vacuum. However, special curing bags of this type are not inexpensive and such design will result in higher costs.

Flanges are often used as a holding means in final assembly. If such flanges are undesirable they may be eliminated by the use of inserts as shown in *Fig.* 10. Conventional inserts of the knurled type cannot easily be molded in place in plastics of this type because of the laminated construction. Instead, where high strength is required, the inserts should be of the T or U-bolt type as indicated in the illustration. The stud is normally inserted through a hole in the fabric before curing in order to increase its holding power, therefore a flange is actually produced. This is machined off to produce a square shoulder. The flange can, of course, be left on if so desired. When conventional knurled inserts are desired, they are secured in place by cementing into holes machined into the part after molding.

Keep Wall Sections Uniform

The basic idea of retaining uniform wall sections in design should also be followed in shapes other than hollow. *Fig.* 11 illustrates the right and wrong design for an L-shaped part. The square shoulders are difficult to produce and if the design permits should preferably be omitted in favor of a soft curve. The stiffening ribs illustrated in the left-hand sketch could be produced by cementing on additional material, however, weak points would be created. Shown in *Fig.* 12 is another example of the right and wrong ways of designing laminated parts. In this actual case, corrugations were desired and the part was designed with several ridges producing points of increased thickness. This could have been accomplished by molding the laminations over suitable filler cores, but by merely designing "waves" into the material at these points, corrugations were obtained and the material held at an even wall thickness.

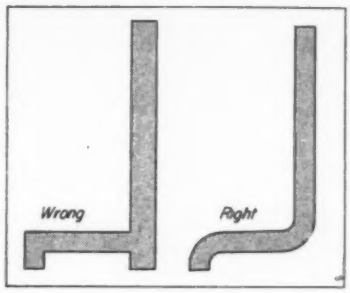
Sharp corners, *Fig.* 13, should be avoided in all laminates. In parts made over male forms the material will generally become thinner at the radius than elsewhere. Hence a shape molded over a sharp inside corner may have an outside radius which is equal to twice the laminate thickness. Where a sharp outside corner is essential several alternatives can be used. A female form can be used but it is difficult to prevent voids at the sharp corner and a special filler is usually placed in the corner under the laminate thus allowing the cloth to take a broad sweep. The material in the corner is thus not part of the continuous fiber of the laminate and will not be as strong as the rest of the piece. An alternative to this, where the piece is not to carry much stress, is to mold over a bulge on the male form and then machine the outside surfaces to the required sharp corner.

Cylindrical or symmetrical hollow shapes can be made, as was the duct mentioned previously, by wrapping the fabric around a mandrel and then removing the mandrel by driving it out (in the case of a

(Concluded on Page 156)

Fig. 11—Right—Parts should be designed so as to eliminate ribs, left. Preferred design allows smooth "flow" of laminate

Fig. 12 — Below — Wrong and improved methods of obtaining ridges on laminated parts



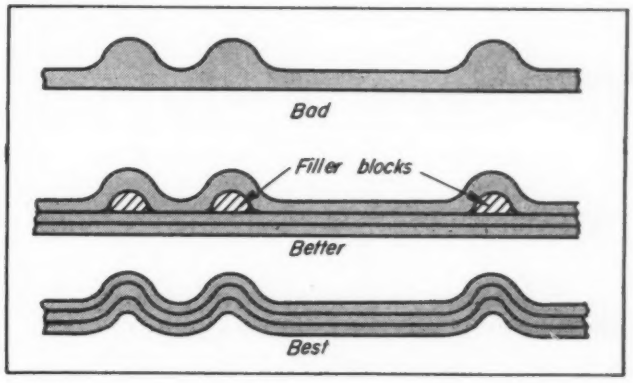


Fig. 13—Below—Possible corner designs. Rounded corner, (a) is best design. If part must fit a sharp-cornered mating assembly, design (b) may be used although corner is weakened. Shown at (c) is effect of sharp internal corner. Laminate material is pulled thin over the sharp edge. Sketches (d) and (e) show methods of producing stronger sharp internal corner. These techniques increase costs and produce weak points if bulges are removed

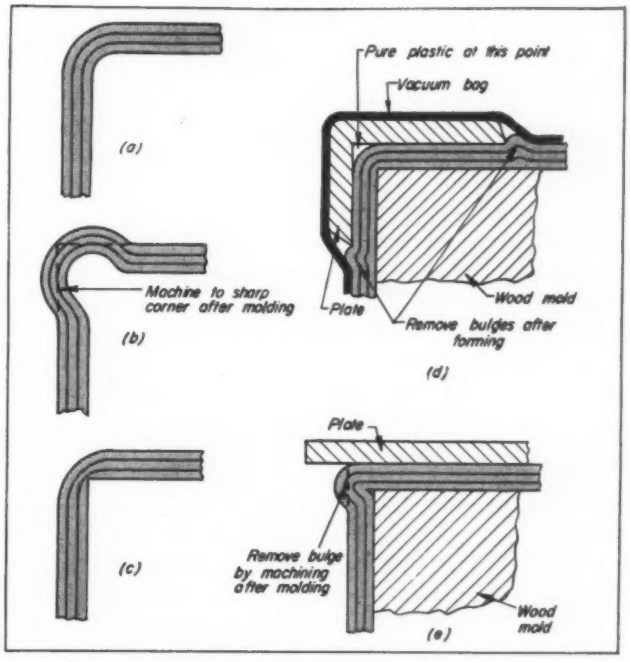
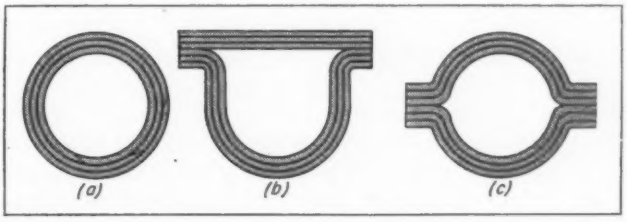


Fig. 14—Right—Three designs for tubular parts. Type (a) is relatively expensive. Types (b) and (c) are each molded in two parts and then cemented together



Design Innovations in Yarn Spinner

. . . include worm-driven screw jacks, novel reciprocating mechanism and twenty-spindle belt drive

By G. F. Norcross

Chief Engineer
McGlynn Hays Industries Inc.
Belleville 9, N. J.

DESIGN of the McGlynn Hays ring spinning machine, *Fig.* 1, incorporates several interesting innovations: A rising draft mechanism, a worm-driven ring-rail lifting mechanism and a twenty-spindle endless-belt drive.

RISING DRAFT MECHANISM: As the drawing, *Fig.* 2, shows, the rising draft field is composed of seven individual shafts, each 50 feet long, which control the fibers prior to the actual spinning of the yarn. It is imperative that alignment of these shafts be maintained. Also, to spin a large package, raising the draft field is necessary. Thus, the field is mounted on stands, which in turn are bolted to a 50-foot long structural angle (draft rail). To provide proper alignment, the angle has to be raised, without sag, a distance of five inches. This is accomplished by an individual, automatically-controlled, electric motor driving worm-screw jacks placed at five-foot intervals, making a total of eleven jacks in all. Upon automatic impulse, the motor is actuated and elevates the complete draft field. One revolution of the jack shaft itself results in a 0.005-inch vertical motion of the draft rail. Vertical alignment is achieved by mounting the structural angle to the machine frames through the use of parallelogram arms. Of course this means that the draft field will move forward and back a slight amount as it raises and lowers. However, this does not affect the spinning of the yarn in any way.

RING-RAIL LIFTING MECHANISM: Yarn is spun onto the package by the medium of a traveler which is carried on a ring concentric with the spindle. The yarn passes through an eyelet above the package, then passes through the traveler and winds onto the package. Since the spindle is driven, it is only the tension in the yarn which causes the traveler to rotate. The building of a proper size and shape package depends upon the controlled motion of the rings. As the McGlynn Hays machine has 200 spindles on each side, 20 rings are mounted on 10 ring rail sections running the length of the machine. The proper motion of the ring rail is controlled by a "bobbin builder mechanism" which is shown in the drawing of *Fig.* 3.

Bobbin Builder Oscillated By Cam

The bobbin builder housing is pivoted at one end and the opposite end is held against a cam having a 2-inch throw. This cam shaft revolves at a predetermined speed depending on the type of yarn being spun. The bobbin builder is a worm and wheel mechanism. On the wheel shaft is a chain drum to which one end of a cable chain is attached. The other end of this chain is run over a pulley and attached to a horizontal pull bar running the length of the ma-

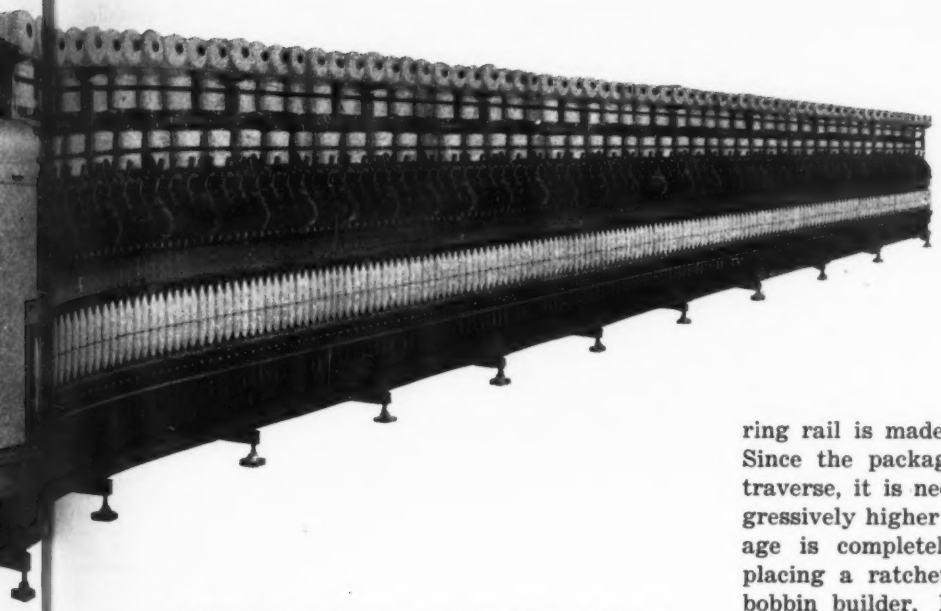
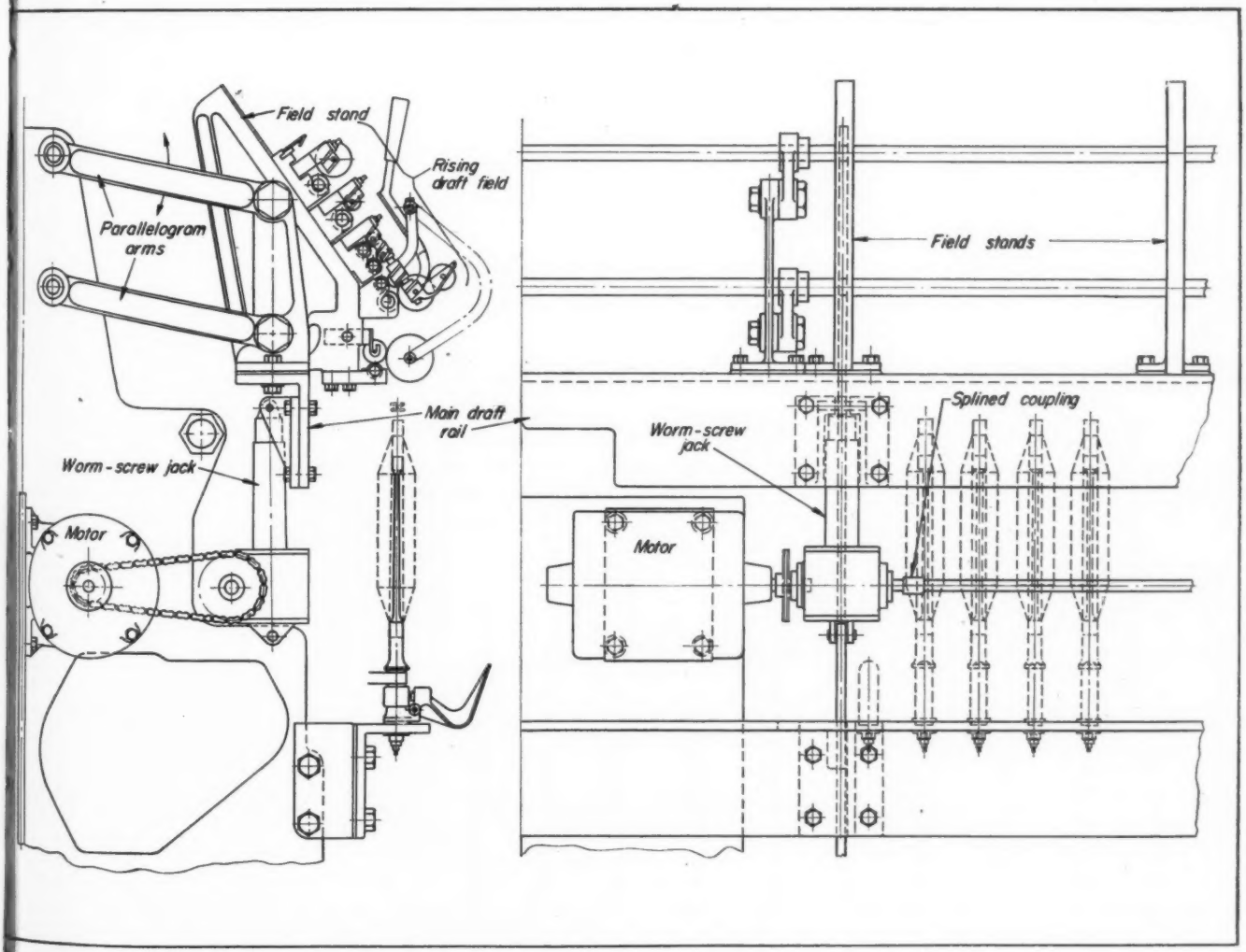


Fig. 1—Left—Modern ring spinning machine incorporates numerous design innovations

chine. At five-foot intervals along this pull bar, additional chains are attached and run over pulleys down to the bottom of the ring rail holder lift bars. Thus, as the bobbin builder is oscillated up and down two inches by the motion of the cam, by translation of this motion through the pull bar and chains, the ring rail is made to oscillate 2 inches down and up. Since the package requires winding over a 10-inch traverse, it is necessary to have this oscillation progressively higher on the package tube until the package is completely spun. This is accomplished by placing a ratchet wheel on the worm shaft of the bobbin builder. Pivoting on this worm shaft is an arm carrying a pawl. The far end of the arm is attached to the frame of the machine by a chain which

Fig. 2—Below—Chain-driven from motor, worm-screw jacks placed at five-foot intervals, raise and lower 50-foot draft rail at uniform rate over its entire length



is adjusted to have slightly less than 2 inches of slack. As the bobbin builder oscillates by action of the cam, the chain becomes taut near the lower end of the stroke, causing the pawl to rotate the ratchet plate on the worm shaft. This causes a slight rotation of both the wheel shaft and the chain drum.

Resultant motion of the ring rail is such that its upward movement is always 2 inches while its downward stroke is slightly less. This method of winding a package is known as a "filling" wind and the package is complete when 8 inches of chain have been wound onto the chain drum of the bobbin builder. Translation of the pull bar and ring rail through 8 inches, plus the 2 inches of oscillation caused by the cam, account for the 10-inch traverse of the ring rail.

SPINDLE DRIVE: Since the machine has 200 spindles on each side, it involves a unique type of spindle drive, shown in *Fig.* 4. In the past it has been shown that spindle stoppages due to belt breaks were almost in proportion to the number of joints in the belts. This machine has 20 spindles on one continuous belt with continuous hard-drawn aluminum tubes used in lieu of pulleys. By this design, life of the thin cloth belt has been increased considerably over methods now normally found in use. The seamless aluminum tubes are held in splined bearings which are supported in each intermediate frame of the machine and are connected through quickly removable splines. There are ten drums in one line. The main drive is provided through an 8-inch diameter drum, while a 4-inch diameter drum is used immediately forward of the larger drum for idler purposes only.

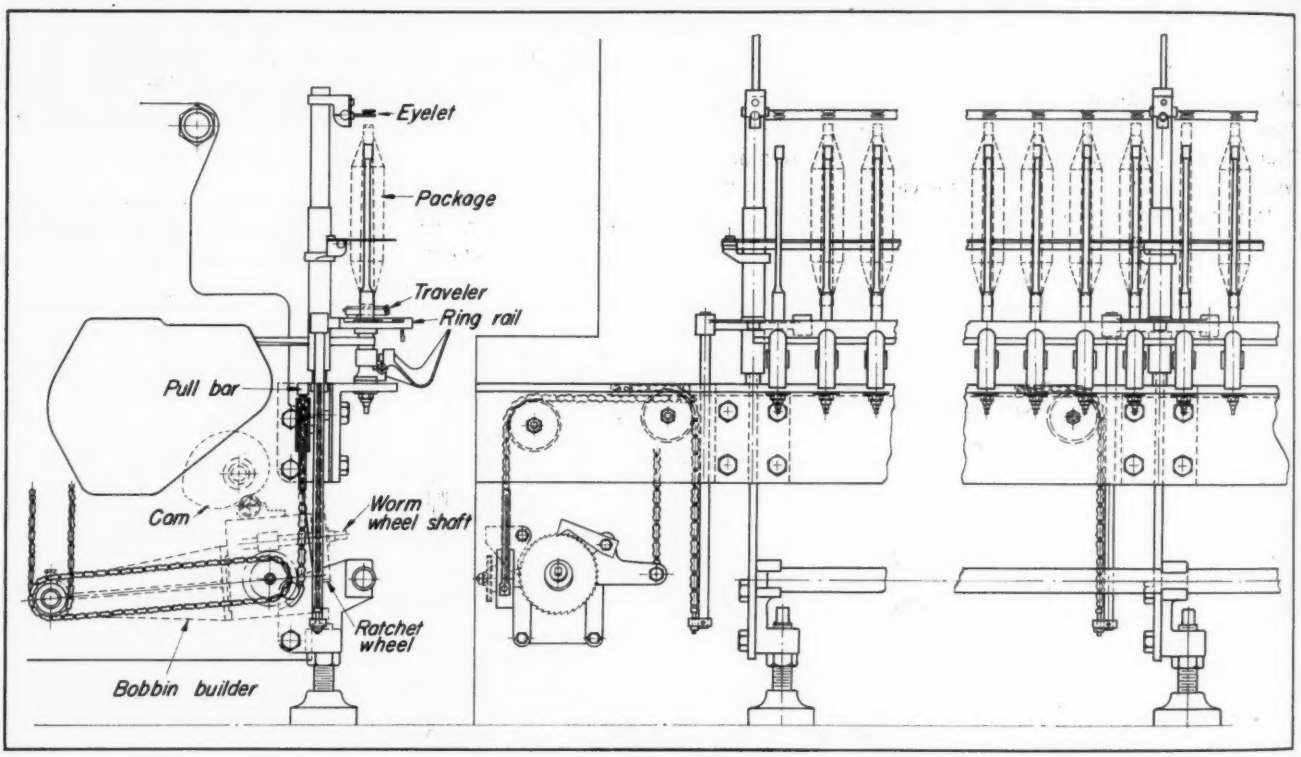
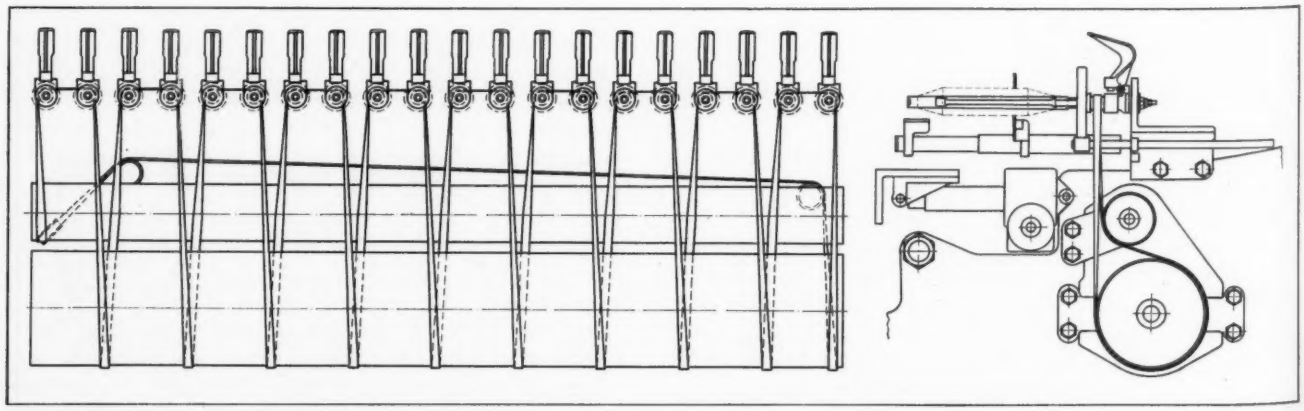


Fig. 3—Above—Cam-actuated bobbin builder employs chain to vertically oscillate the ring rail continuously. Action of ratchet is such that oscillating ring rail moves progressively higher up the package

Fig. 4—Below—How continuous belt of thin cloth is used to drive twenty spindles. Both long pulleys—driver and idler—are continuous hard-drawn aluminum tubes mounted on splined bearings



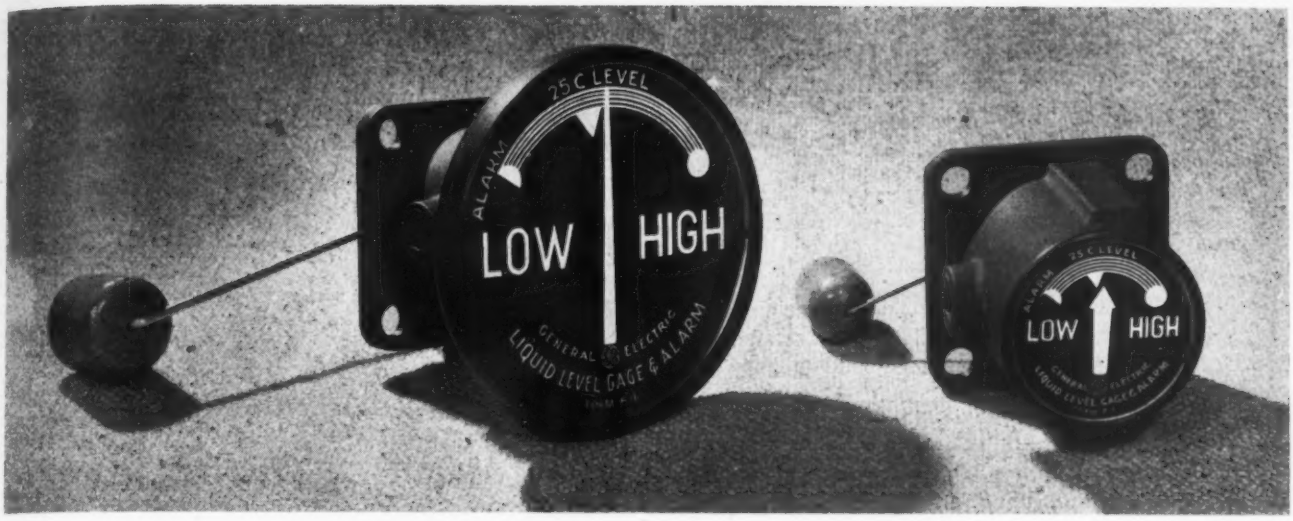


Fig. 1—Liquid level gages made by the Boston Auto Gage Co. utilize two sintered Alnico magnets to provide a leakproof coupling between the float mechanism and the indicator

Permanent Magnets in Design

By R. J. Studders

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IN RECENT years permanent magnets have found an ever increasing number of uses in industry. There are many outstanding advantages to the use of a magnetic field maintained by a modern permanent magnet material, *Fig.* 1, rather than the conventional wound field. A very definite space and weight saving may be realized with the use of permanent magnets, except in instances where it is necessary to create an extremely large or intense magnetic field. Self-contained and consuming no electrical

Fig. 2—Typical permanent magnet hysteresis loop obtained by plotting induction against magnetizing force

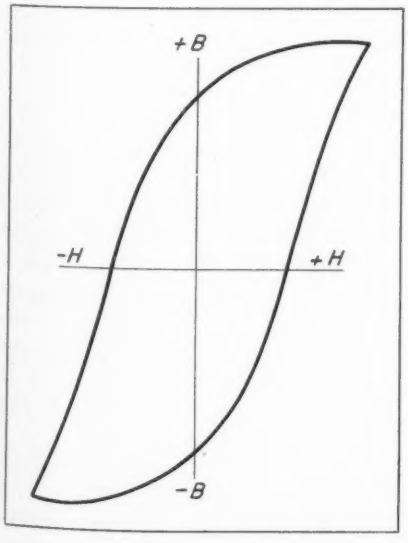


Fig. 3—Second quadrant of the loop in Fig. 2, known as the demagnetization curve, supplies most useful data

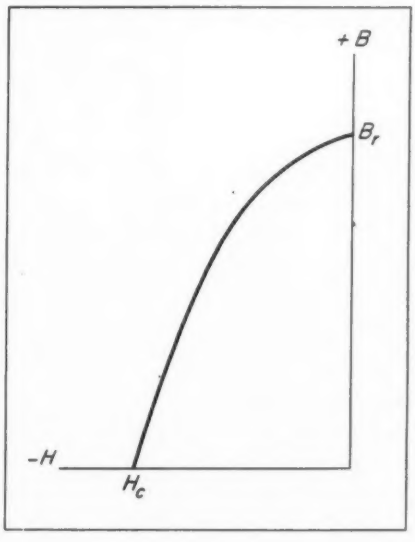
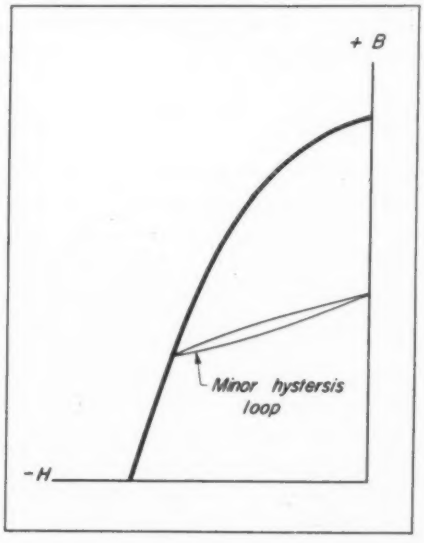


Fig. 4—Typical minor hysteresis loop under the demagnetization curve used in dynamic design calculations



energy in use, permanent magnet apparatus requires no provision to dissipate the heat normally developed by an electromagnet. Over long periods of time permanent magnets have repeatedly proved to be extremely stable and dependable sources of magnetic fields.

The functions of permanent magnets may be divided into two rather general classifications. In the first will fall those applications which are essentially concerned with the conversion of energy from one form to another. In the second group are all those applications which utilize a tractive force, the force of attraction between a magnetic field and magnetic materials, or in rarer cases, a force of repulsion between like magnetic poles.

Considering first the energy transforming uses of permanent magnets; these are usually concerned with the conversion of mechanical energy into electrical, or electrical energy into mechanical. With a

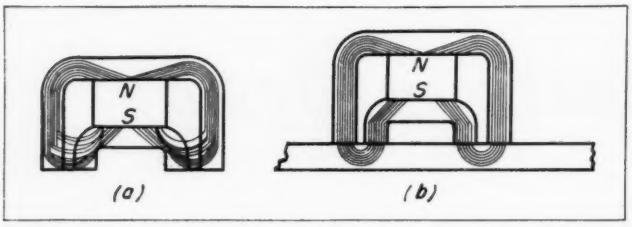


Fig. 5—General design and operation of permanent holding magnet assembly, (a) being without a keeper

mechanical force available, a generator or magneto may be utilized to obtain electrical energy. In simple terms, the mechanical force is so applied as to create a relative motion between an electrical conductor and a magnetic field maintained by a permanent magnet. Such motion will cause an electric current to flow in the conductor. In the opposite type of energy conversion, a current carrying conductor will exhibit mechanical motion when immersed in a magnetic field following the well-known laws of physics. This is essentially the principle of operation of the permanent magnet loudspeaker. The electric motor is another example of the conversion of electrical energy although operating on a somewhat different principle than the loud speaker.

Use of Tractive Forces

The second general function of a permanent magnet is to supply a tractive force. The basis for such a force is the fact that unlike magnetic poles attract one another, while like poles exhibit repulsion. There is a magnetic polarity induced in ferromagnetic materials in the presence of an exciting magnetic field. If this magnetic field is maintained by a permanent magnet, there is a force of attraction between the poles of the magnet and the poles induced in the magnetic material. This mechanical force, varying as the magnetic pole strengths and the distance between them, has been usefully employed in a variety of applications.

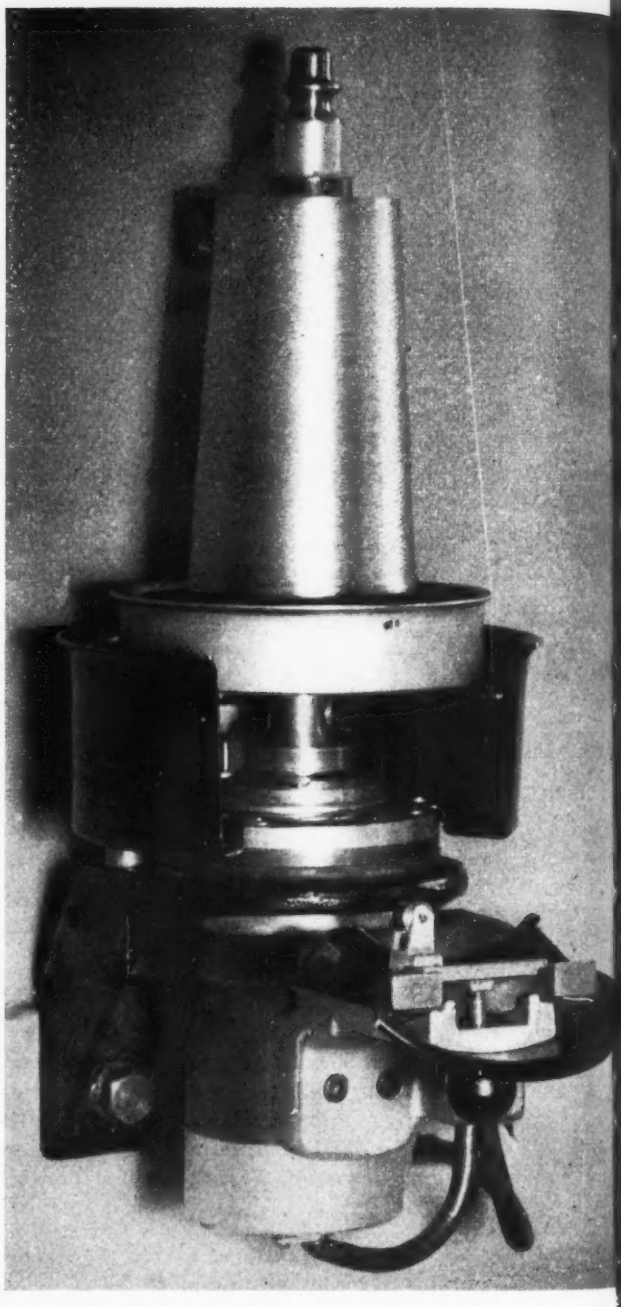


Fig. 6—Saco-Lowell 2-for-1 yarn twister drive mechanism utilizes permanent magnets to provide positive drive with automatic safety release in event of operational trouble

PERMANENT MAGNET MATERIALS: The ever increasing demand for permanent magnet apparatus is in large measure attributable to the improved magnetic properties of modern magnet materials. Probably one of the greatest advances in permanent magnet technology was the development of the anisotropic alloy, Alnico 5. This alloy has multiplied the magnetic energy available from a given volume of material by four or five times. Consequently, much effort has been concentrated on the manufacture of Alnico 5 and its modifications with a uniform and high magnetic quality.

A partial list of magnetic properties of some of the more important alloys is given in TABLE I. The Alnico family of alloys are very hard and nonmachinable.

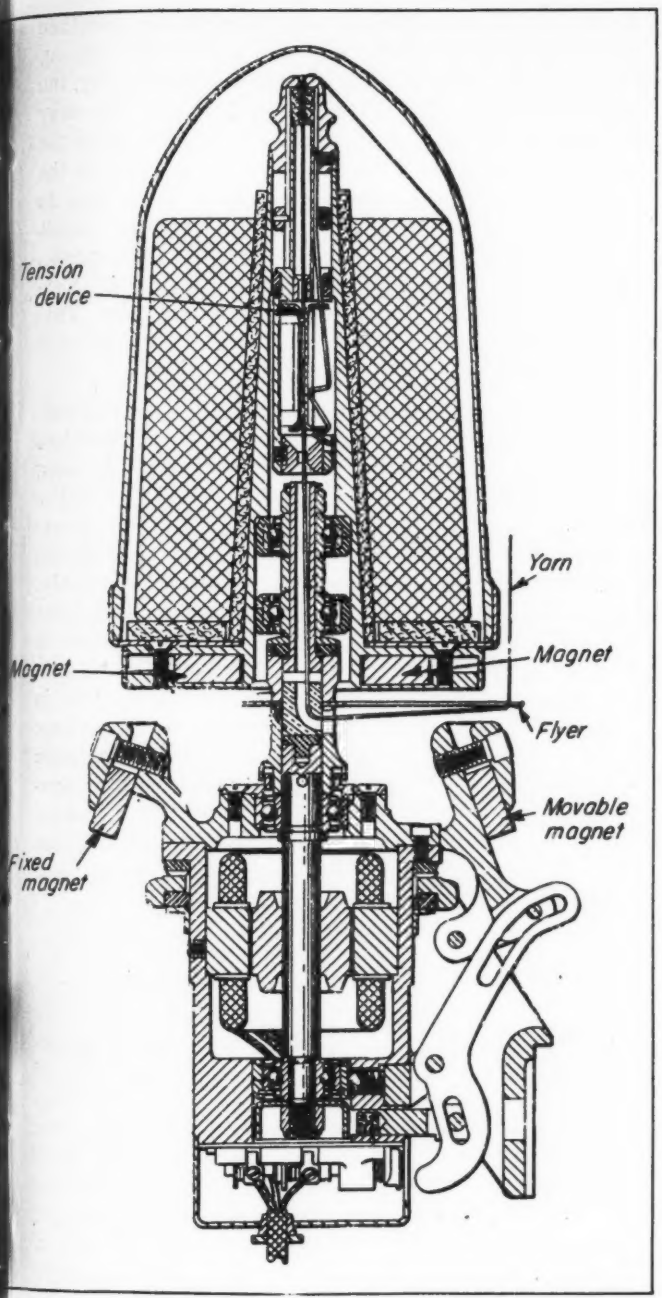


Fig. 7—Cross-sectional view of the yarn twister showing the magnet arrangement and safety release mechanisms

They must be ground to final dimensions if close tolerances are to be maintained. The smaller-size Alnico magnets may be more economically manufactured to closer tolerances by utilizing the powder metallurgy methods of manufacture. Cunico is machinable and workable, but its magnetic properties are not too attractive for most work. Cunife and Vicalloy are also both machinable and workable. Further, their magnetic properties are dependent upon the amount and type of cold work given the alloy after quenching. These alloys are usually used in the form of wire or sheet. Vectolite is a unique nonmetallic magnet material with a high electrical resistivity and low specific gravity.

PERMANENT MAGNET DESIGN: Proper utilization of the available magnet materials requires that close attention be accorded such factors as cost, electrical and physical properties and, in some instances, space consumption. Precise calculation and comparison of magnetic circuits is a lengthy and tedious procedure, generally unfamiliar to the designer. As a consequence, permanent magnet design still is considered somewhat of an art and often is left to a few experienced engineers. Outlined below are the general methods used to arrive at a first approximation of magnetic circuit dimensions.

Second Quadrant Supplies Data

If the measured induction of a magnet in a completely closed magnetic circuit is plotted as a function of the external magnetizing force, the magnitizing force varying between limits which will saturate the material, the common hysteresis loop shown in *Fig.* 2 is obtained. The second quadrant portion of this loop, *Fig.* 3 is called the demagnetization curve and supplies much of the data used in magnet design.

TABLE I

Properties of Important Magnetic Alloys

Alloy	Coercive Force (Hc, oersteds)	Residual Induction (Br, gauss)	Max. Avail. Energy (BH Max. gauss-oersteds)
Alnico 2	540	7200	1,600,000
Alnico 3	400	7100	1,400,000
Alnico 5	575	12000	4,500,000
Alnico 6	750	10000	3,500,000
Alnico 12	1000	5800	1,800,000
Cunico	650	3200	850,000
Cunite	350–600	4–5800	1–2,000,000
Vicalloy	300–500	8–9500	1–3,500,000
Vectolite	900	1600	600,000

In many applications the required magnetic field is essentially static and the permanent magnet is subject to only very small demagnetizing influences. The magnet in such a static circuit is assumed to operate at one point on the demagnetization curve. The product of B and H for any point on the magnet demagnetization curve is proportional to the energy externally available per unit volume of magnet material, and there is one point on this curve for which the BH product is a maximum. It may be shown that when the magnet is made to operate at its point of maximum energy, a minimum amount of magnet material will be required to maintain a given amount of flux in the air gap. Nearly all useful magnet applications have an air gap in the circuit. This circuit air gap by its very nature will exert a demagnetizing influence on the magnet. There will also be a certain amount of flux leakage about the circuit which will be unavailable to the air gap. In static applications the task of the designer is to regulate the magnet and circuit dimensions to minimize the leakage and have the magnet operating at the point of maximum energy on its demagnetization curve after initial saturation.

The greater number of magnet applications are dynamic in nature as contrasted to the static type discussed above. For reasons of stability, assembly problems, or operating conditions, the magnet in a dynamic application is subject to significant demagnetizing influences. Under such conditions the operat-

ing point of the magnet will move along a minor hysteresis loop, and design will no longer be concerned with the maximum energy point on the demagnetization curve. A typical minor hysteresis loop lying under the demagnetization curve is shown in *Fig.* 4. In this case, for minimum volume of material, the circuit and magnet dimensions are selected so that the magnet operating point will move along the proper hysteresis loop. As has been indicated earlier, the energy available externally from a permanent magnet in a circuit containing an air gap is composed of two parts, the useful and the leakage. In dynamic applications it is necessary to design the circuit to obtain a maximum of useful energy and, thereby, utilize a minimum of magnet material. To regulate the magnet so that it will operate on the most efficient minor hysteresis loop, it is necessary to control the circuit leakage rather than minimize it as in the case of static applications.

Industrial Applications

HOLDING MAGNETS: One of the most popular and useful permanent magnet applications is the holding magnet assembly. These assemblies are manufactured in a wide variety of sizes and types, with the pull required to remove them from a piece of steel varying between 2 and 500 pounds. Their general design and operation is indicated in *Fig.* 5. A cutaway drawing of a typical assembly with no keeper across its poles is shown in *Fig.* 5*a*. Most of the available flux in this case traverses the shunt air gap. With the assembly placed on a piece of steel, *Fig.* 5*b*, most of the flux passes through the steel with very little remaining in the air gap. The pull required to remove the holding assembly from the steel will be proportional to the product of the pole area and the square of the flux density at the pole faces.

The holding magnet assembly has almost an unlimited number of applications in industry. Another advantage may be gained by the use of the holding power of permanent magnets as exemplified by the Saco Lowell 2-for-1 yarn twister, *Fig.* 6. As may be seen in *Fig.* 7, the magnets are used to hold the yarn cone assembly stationary with respect to the rotating spindle through a considerable air gap. In the event of a jam, rotation of the assembly repels the movable magnet to stop both motor and spindle. This simple method of holding with an air gap permits 360-degree rotation of the flyer and yarn. This flyer rotation adds another turn to the yarn before it is wound on the take-up spool.

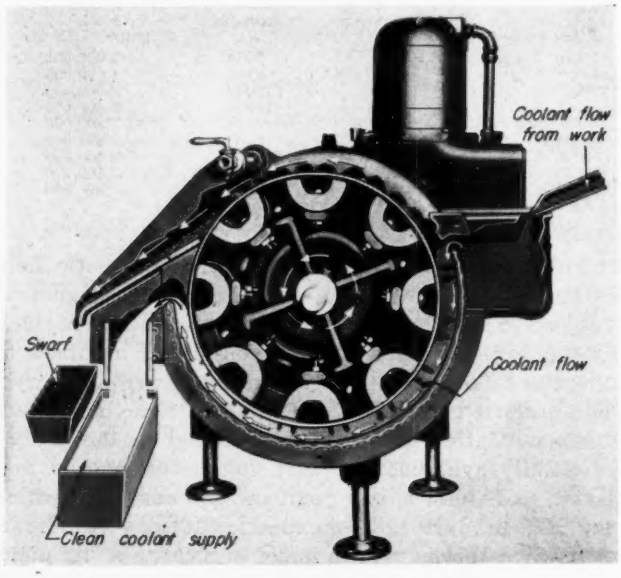


Fig. 8—Cross section of the Barnes Drill Co. magnetic separator which uses permanent magnet collectors

EDDY CURRENT DEVICES: An interesting use of permanent magnets is in plugging controls for brakeless stopping of polyphase induction motors by reversing the power to the motor. The heart of this control is an eddy current disk driven by the motor in a permanent magnet field mechanically separate from the motor. As the disk rotates in the magnet assembly, the eddy currents produced in the disk tend to twist the magnet assembly about its axis, i.e., create a torque. As the speed of the motor approaches zero with the power reversed, the decrease in torque is used as a means to interrupt the circuit and prevent the motor from reversing directions. Stopping times on the order of one second are common with this control. Eddy current devices with permanent magnets, such as described above, are essentially frictionless except in the bearings and, consequently, they are characterized by a long, useful life.

Magnetic Separation Advantages

MAGNETIC SEPARATORS: Magnetic separator apparatus has a wide variety of uses in industry. One of the best applications utilizing the advantages of permanent magnets is the magnetic coolant separator for honing and grinding machines. With this machine there is no undesirable temperature rise in the coolant due to its passage through the permanent magnet separator. *Fig.* 8 is a cutaway drawing of such a separator showing its construction. The magnetic particles are attracted to the pole area of the revolving magnets, removed from the coolant liquid, and deposited in a separate bin. This separator is so designed that the attracted magnetic particles form a filter to also remove much of the abrasive material from the coolant.

TRANSMISSION OF MOTION: To prevent leakage or contamination it is many times desirable to transmit simple mechanical motion through a wall without piercing the wall. A magnetic coupling with permanent magnets offers a simple solution to this problem. The liquid level indicators shown in *Fig.* 1 illustrate the use of such couplings. The rise or fall of the float actuates the dial pointer through the medium of the permanent magnet coupling.

These are but a few of the many present day applications of permanent magnets. There are many untouched fields where permanent magnets may assist in doing a better job more economically than otherwise possible.

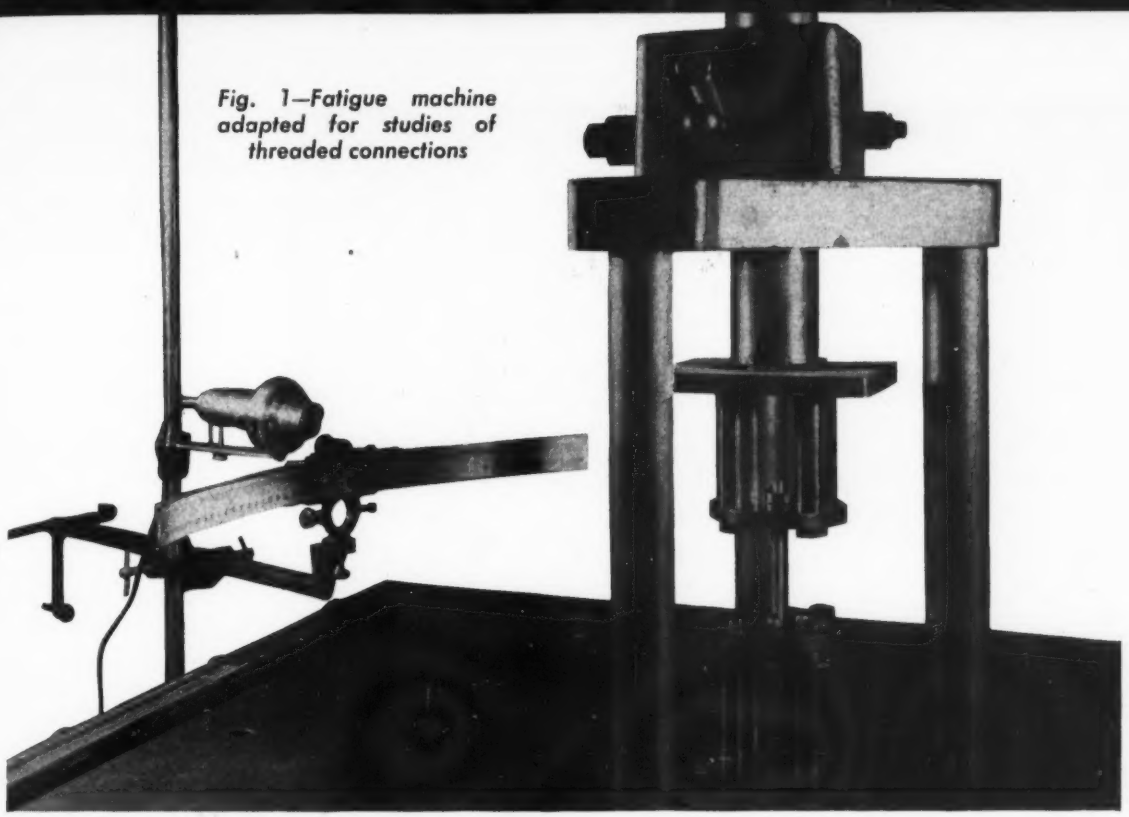


Fig. 1—Fatigue machine adapted for studies of threaded connections

Obtaining Fatigue-Test Data

By J. A. Sauer and P. K. Roos
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Department of Engineering Mechanics
The Pennsylvania State College
State College, Pa.

FOR fatigue studies under combined stress conditions, the Sonntag fatigue testing machine[1] is easily adaptable for testing under various stress combinations. Its flexibility permits superposition of static loads so that mean stresses other than zero can be studied. In fact the apparatus—consisting of a centrifugal force oscillator with built-in inertia force compensator—is more ideally suited for such applications than it is for its basic function of studying the fatigue properties of materials under simple stress conditions. Its ability to superimpose alternating forces of constant amplitude in tension-compression, bending or torsion on any desired static preload

[1] The development and construction features of this apparatus are discussed by B. J. Lazan in his article "Fatigue Testing Machine", MACHINE DESIGN, May, 1947, Pages 123-127.

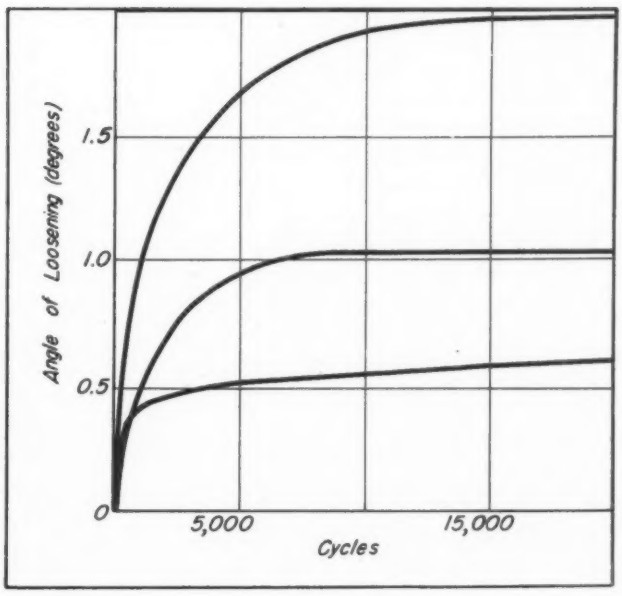


Fig. 2—Typical nut loosening curve for a 5/16-18, Class 3 fit. Nuts and bolts are cadmium plated steel. Loading was 500 pounds static and 450 pounds dynamic

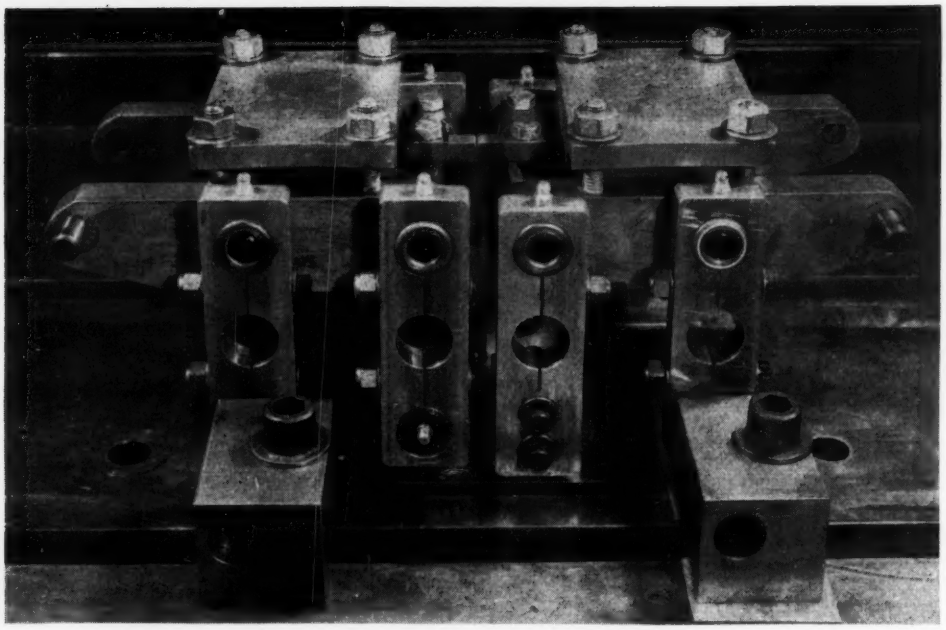
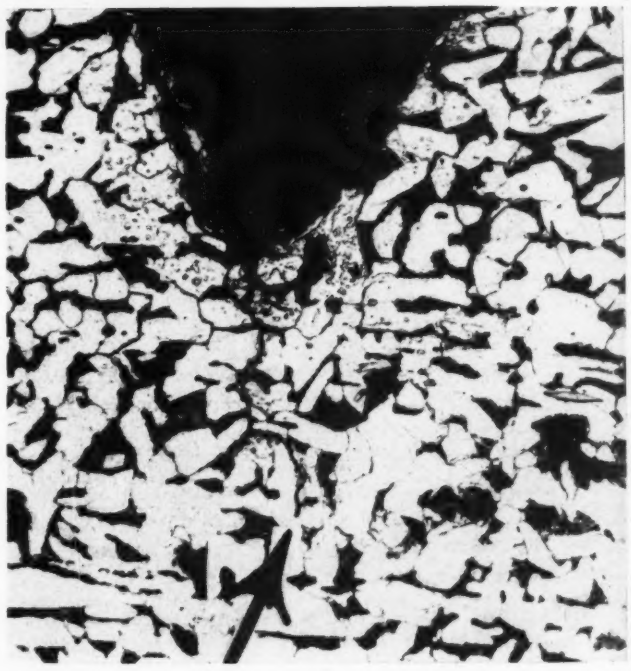


Fig. 3—Left—Bending fixture adapted for impact specimens

Fig. 4—Below—Typical shallow fatigue crack produced at the base of a machined notch (magnification 250X)



combine to provide a machine of extreme usefulness.

Three specific applications in which the Sonntag apparatus has been found to be useful are:

1. As a means of providing various types of vibratory conditions for the study of nut-bolt action.
2. As a means of producing controlled cracks within a material for research work on the effect of such cracks on mechanical properties
3. As a means of simultaneously applying various combinations of alternating bending and torsional moments to permit determination of their resultant effect on the fatigue characteristics of a given material.

In each of these instances, suitable jigs and fixtures are required for holding the specimen or assembly and for adapting the inertia-force oscillator to the purpose in mind. Design modifications and testing procedure, together with some of the preliminary test results and tentative conclusions, will be given in order that the universal nature of the apparatus and its applicability to various types of research projects may be evident.

NUT-BOLT ACTION UNDER VIBRATORY FORCES: The loosening or fatigue of threaded connections under the action of vibratory forces has long been a problem of considerable importance to design engineers. In applications where failure of a single threaded connection would be disastrous, such as the attachment of an airplane engine to the engine supports, designers have required the use of locknuts, have specified control of initial tightness, and have insisted on the use of high-strength alloy steels of high endurance limit for both the nut and bolt materials.

Little test data are available, however, on which to base quantitative or sometimes even qualitative specifications of these various factors. Some interesting and important contributions to this field of knowledge have recently been made by Almen[2], and Goodier and Sweeney[3]. Nevertheless, it is still difficult to answer such vitally important questions as: What should the initial bolt tightness be? What effect does this tightness have on the fatigue characteristics of the joint? If properly tightened, is a locking device still required? Which type of locking device will prove most satisfactory? Will some degree of loosening still occur? Is the amount of loosening a function of the amount of preload removed by the vibration, of the frequency of the vibration, of the type of thread or thread fit used, and of the total number of cycles?

The Sonntag fatigue machine is well-suited for supplying test data to help answer questions of this

[2] Almen, J. O.—"On the Strength of Highly Stressed, Dynamically Loaded Bolts and Studs", *SAE Journal* (*Trans.*) Vol. 52, No. 4, April, 1944.

[3] Goodier, J. N. & Sweeney, R. J.—"Loosening by Vibration of Threaded Fastenings", *Mechanical Engineering*, December, 1945, Pages 789-803.

type and for throwing light on the effect of the various variables entering into the problems. For a study of failure due to fatigue alone, no special modifications of the machine are necessary. The test bolt and nut need only be mounted between the reciprocating platen and the fixed platen of the machine, as shown in *Fig.* 1.

The nut and bolt combination may be initially tightened by means of the static preload springs or by means of a torque wrench. Any desired reciprocating load can then be superimposed on the tightened assembly and the number of cycles to failure noted. In this manner, effect of such variables as nut and bolt material, initial tightness or applied torque, and type of thread on the fatigue performance of the joint may be studied.

There are two limitations that should be pointed out. First is that only small sizes of nuts and bolts can be tested due to the limited capacity (1000 pounds static load, 1000 pounds superimposed dynamic load) of the machine; and the second is that a relatively slow operating speed (1800 rpm) makes accumulations of data rather tedious.

For studying the effect of the various variables on the loosening of the threaded connection rather than on its fatigue strength, the additional apparatus shown in *Fig.* 1 has been found to be suitable. It consists of a light source, a small mirror glued to the hex side of the nut and a scale for reading the motion of the reflected light. In operation the head of the bolt is fixed to prevent rotation so that any movement of the light ray on the scale is due to relative rotation of the nut on the bolt.

Typical loosening curves, i.e. amount of loosening in degrees of rotation versus number of alternating cycles, are shown in *Fig.* 2. It appears that the rate of loosening decreases rather rapidly with increasing load cycles and tends to approach zero. The effect of such other variables as the amount of initial or static load tightness, the ratio of dynamic loading to static load, and the roughness and class of fit of the contacting thread surfaces are now being studied.

EFFECT OF INDUCED FATIGUE CRACKS ON MECHANICAL PROPERTIES: Effect of small cracks or material imperfections on the strength of a specimen or structure, especially when the specimen or structure is subjected to fatigue loading, is a factor which every design engineer must consider. Probably the most striking example of failure resulting from a crack or other source of stress concentration has been the splitting in two of some Liberty ships when buffeted by ocean storms. Many research projects are now under way in which the effect of stress concentrations on mechanical properties is being studied in the hope of throwing some light on the whole problem

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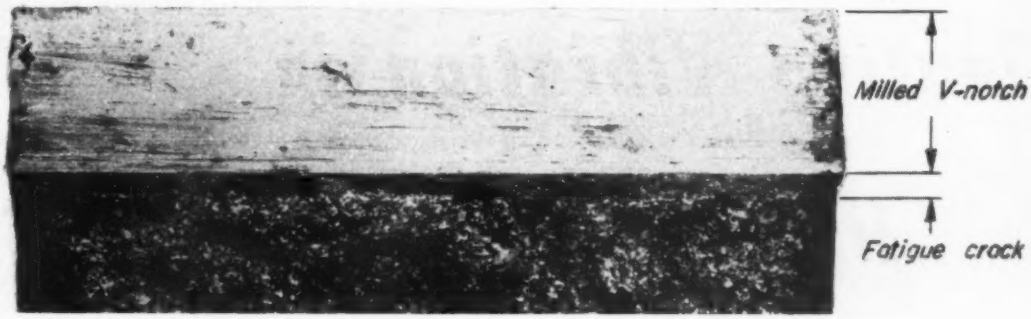

Fig. 5—Above—Fracture of a standard Charpy V-notch, zero-radius bar, showing the shallow crack at the base of the notch (magnification 11X)

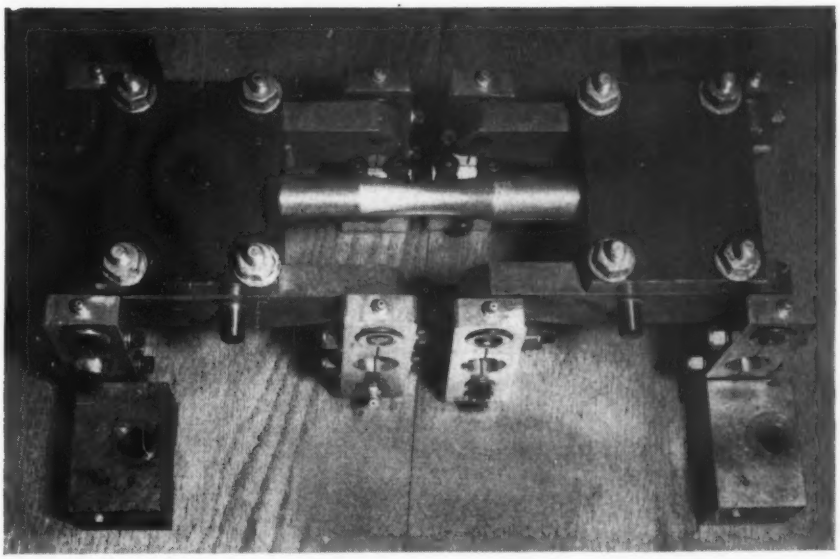

Fig. 6—Right—Bending fixture adapted for round test specimens

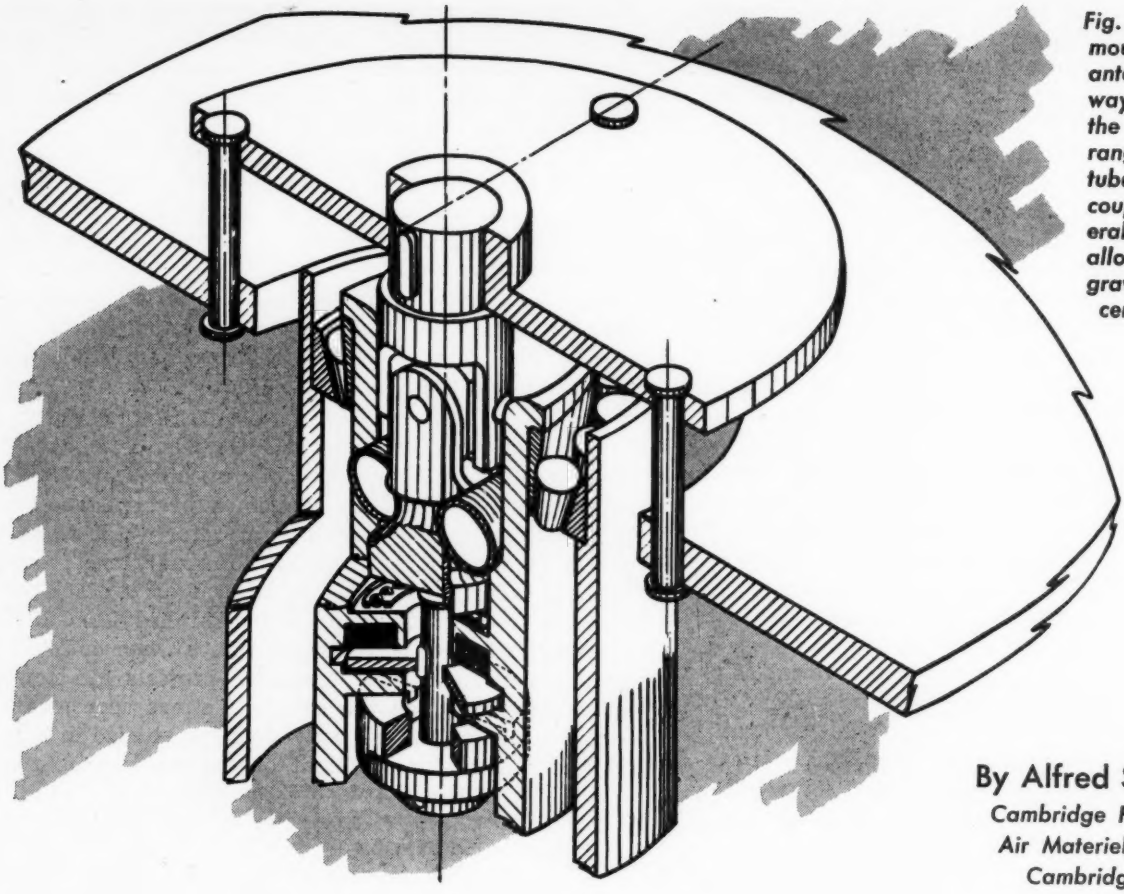

Fig. 1 — Design of mount for a rotating antenna which always operates out of the critical speed range. Pneumatic tube and Oldham coupling permit lateral displacement, allowing center of gravity to seek the center of rotation

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Cambridge Field Station
Air Materiel Command
Cambridge, Mass.

Eliminating Vibration in High-Speed Machines

PERFECT balance in a rotating system is difficult to achieve. Nonuniform distortions caused by temperature changes or stresses often disturb the most perfectly balanced assembly.

In the design of a 24-ft diameter radar antenna revolving at high speed on the top of a tower, particularly severe balancing problems were encountered. Because of its size a fabricated construction was necessary and it was recogized that such a structure could not be made so homogeneous that differential expansion would not occur. The solution lay in a special type of mount developed for the purpose after an extensive survey of existing designs, *Fig.* 1.

This article presents a summary of balancing principles and their application to recent designs, and in-

Fig. 2—Below—Flywheel mounted midway between bearings and slightly out of balance demonstrates the principles of transverse shaft vibration

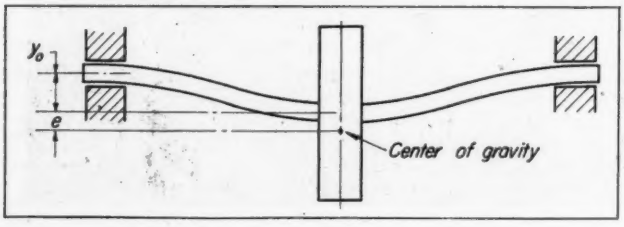
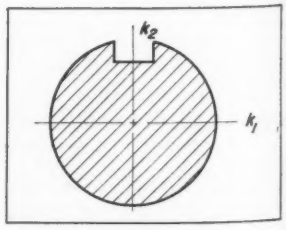


Fig. 3—Right—Shaft with keyway has different stiffnesses in different planes, gives rise to a range of critical speeds rather than a single critical



cludes a discussion of the novel features of the new rotating antenna mount.

CRITICAL SPEED: To demonstrate the causes of destructive vibration in rotating machinery, the simple example of a wheel mounted symmetrically between two bearings, *Fig.* 2, will be considered. Centrifugal force acting on the wheel is

$$C=m(y_o+e)\omega^2=\frac{W}{g}(y_o+e)\omega^2 \quad \ldots\ldots (1)$$

where C = centrifugal force, pounds; W = weight of wheel, pounds; g = acceleration due to gravity, 386 inches per second^2; m = mass of wheel = W/g pounds-seconds^2 per inch; ω = angular velocity of shaft, radians per second = $2\pi n/60$; n = shaft speed, revolutions per minute; y_0 = deflection of shaft, inches; and e = eccentricity of center of gravity of wheel in relation to shaft, inches.

Elastic deflection of the shaft in the position shown is

$$y_o=\frac{W+C}{k} \quad \ldots\ldots (2)$$

where k = elastic constant for shaft deflection, pounds per inch. Substituting from Equation 1 into Equation 2,

$$y_o=\frac{W}{k}\left[1+\frac{y_o+e}{g}\omega^2\right]$$

Solving for y_0

$$y_o=\frac{g+e\omega^2}{\frac{kg}{W}-\omega^2} \quad \ldots\ldots (3)$$

The dangerous condition exists when $\omega^2 = kg/W$, since y_0 tends to become infinite, which would result in fracture of the shaft. This speed is called the critical speed, ω_0. Substituting

$$\omega_o=\sqrt{\frac{kg}{W}} \quad \ldots\ldots (4)$$

into Equation 3,

$$y_o=\frac{g+e\omega^2}{\omega_o^2-\omega^2} \quad \ldots\ldots (5)$$

From Equation 5 it is evident that the shaft, though perfectly balanced and with zero eccentricity, will

Fig. 4—Below—Axial compressive force on shaft causes a decrease in transverse stiffness

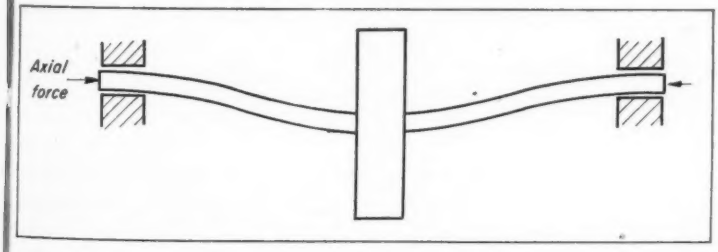


Fig. 5—Below—Unsymmetrical mounting causes gyroscopic forces which change the effective stiffness

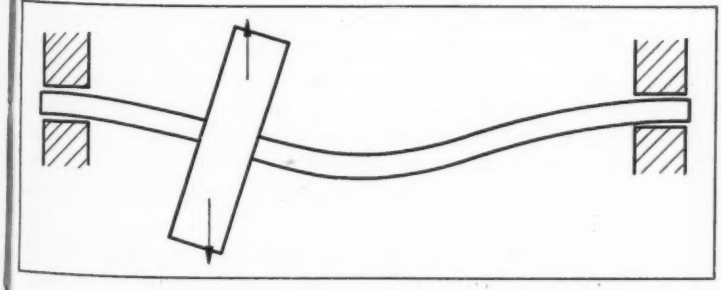
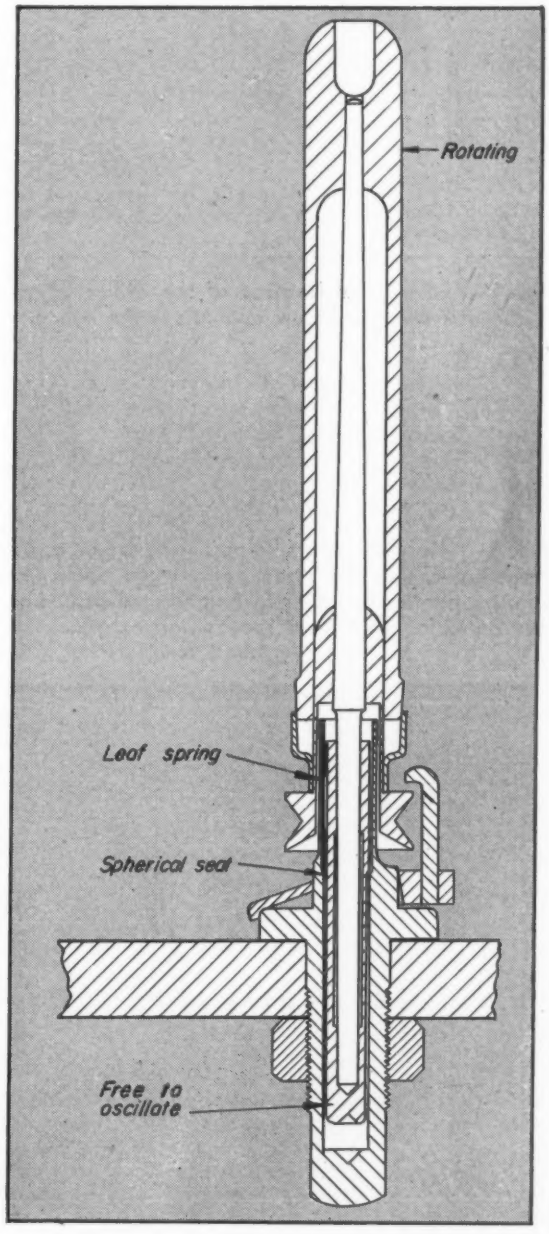


Fig. 6—Right—Textile spindlemount is designed for low critical speed and freedom from gyroscopic forces



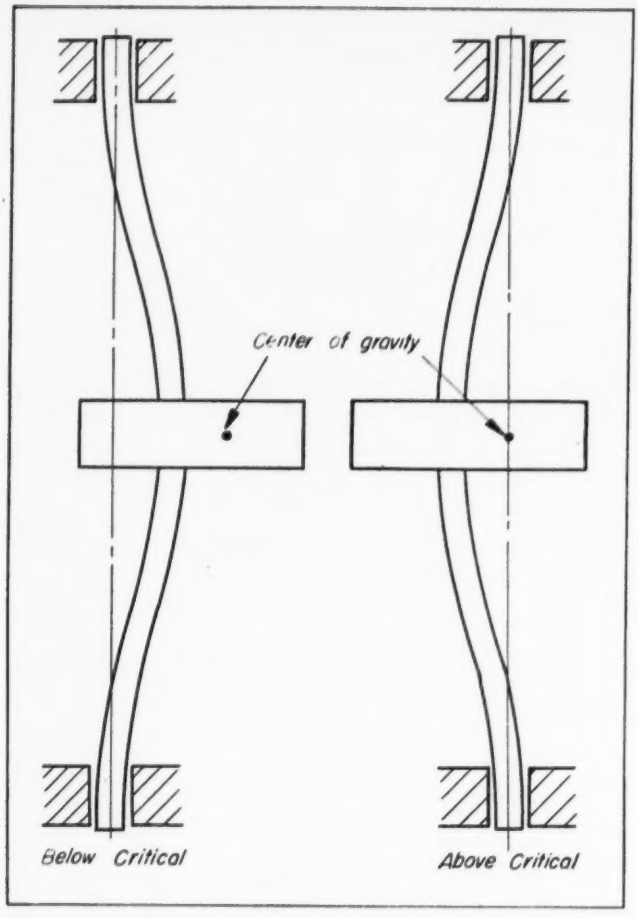
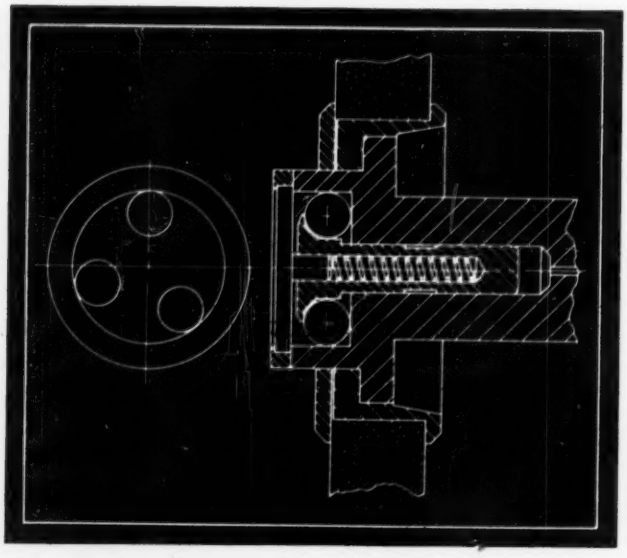


Fig. 7—Above—How location of the center of gravity of the disk changes below and above the critical speed

Fig. 8—Below—Automatic balancing device on a high-speed grinding wheel. The three balls, when unclamped, seek relative positions such as to balance the assembly around the center of rotation at speeds above critical. Drawing, courtesy Cincinnati Grinders Inc.



have large deflections whenever it is run at a speed near the critical speed, ω_0. It is also evident, on the other hand, that an imperfectly balanced structure (with a certain eccentricity e) can be rotated without dangerous deflections, y_0, provided the rotating speed ω is far enough away from the critical speed ω_0.

PRESENT DESIGN PRACTICE: In practical design problems, the operating speed ω is known and it is the task of the engineer to design the rotating system in such a way that the critical speed, Equation 4, is well beyond the range of operating speeds. Good design generally dictates the weight, W, shall be as small as possible. Acceleration of gravity, g, is constant. Therefore the only factor that can be controlled by the designer is the stiffness of the system k.

Two ways to keep the critical speed, ω_0, outside of the operating range are:

1. Design a stiff structure (large k)
2. Design a flexible structure (small k)

A very stiff structure is bulky, heavy and expensive. Therefore, in most cases of high speed rotation, the lighter flexible design is preferred. In this case, it is necessary to pass through the critical-speed range rapidly, which requires sufficient acceleration power in the driving motors. Also, the addition of a damping device may be helpful to reduce vibration amplitude while running through the critical speed. The limitations on this design are:

1. The structure must be stiff enough to support the wheel
2. The structure must be able to transmit the driving torque to the wheel
3. The stiffness of the supporting shaft must be uniform in all radial directions.

The third limitation requires a round shaft. For instance, a shaft with a keyway would have different stiffness in different directions, *Fig.* 3. The critical speed range of such a shaft would lie between

$$\omega_0 = \sqrt{\frac{k_1 g}{W}} \quad \text{and} \quad \sqrt{\frac{k_2 g}{W}}$$

Because of this range it might be difficult or impossible to bring the shaft speed above the upper critical. It must be borne in mind, also, that axial tension will increase the stiffness of the shaft while axial compression will decrease the stiffness, *Fig.* 4. This change of the factor k by axial forces can be determined by applying elastic theory. Furthermore, for unsymmetrical mountings, gyroscopic forces must be taken into account, and this may change the results considerably, *Fig.* 5. It is beyond the scope of this article to treat, in detail, axial forces, gyroscopic forces, unround shafts, shafts with more than one disk, or shafts with more than two bearings, the influence of the mass of the shaft, the influence of non-uniform angular velocity, etc.

However, the principles used in the design of rotating structures will be dealt with. In order to eliminate gyroscopic forces, spherical bearings or universal joints may be provided so that the disk can seek its own plane of rotation. Textile spindles, *Fig.*

6, and centrifuges are good examples of designs free from gyroscopic forces and with low critical speed.

By special design it is possible to arrive at extra flexibility and still retain sufficient support at standstill and the ability to transmit torque. Dynamic forces tend to bring the center of gravity into the center of rotation above critical speed, *Fig.* 7. Sometimes separate flexible masses are added to the ordinary structure. The function of these masses is to bring the center of gravity into the center of rotation and thereby effectively balance the system above critical speed.

The principle of adding movable masses to existing structures has been modified in certain mechanisms which omit elastic springs completely and use, instead, the dynamic forces to move the masses to the proper location. Theoretically, with the omission of elastic springs and the assumption of zero friction, such devices can achieve perfect balancing at speeds above the critical speed. The difficulty in all these mechanisms lies in the fact that the moving masses have to be arranged for concentric motion around the shaft in order to achieve desired results. The slight-

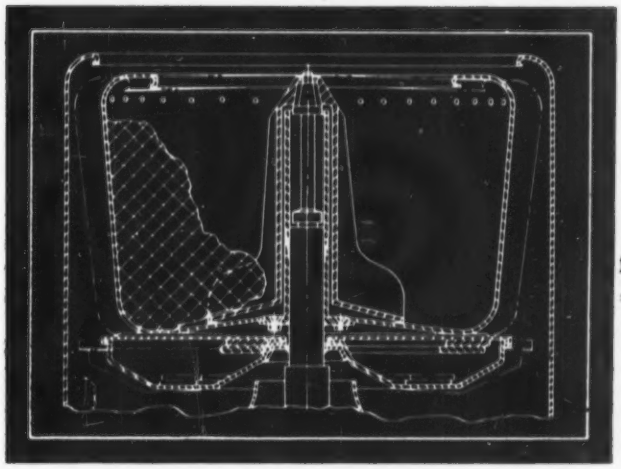


Fig. 10—Two rings riding on a cone and free to seek any radial or axial position provide automatic balancing of the irregular mass of clothes in a washing machine during the spin-dry cycle

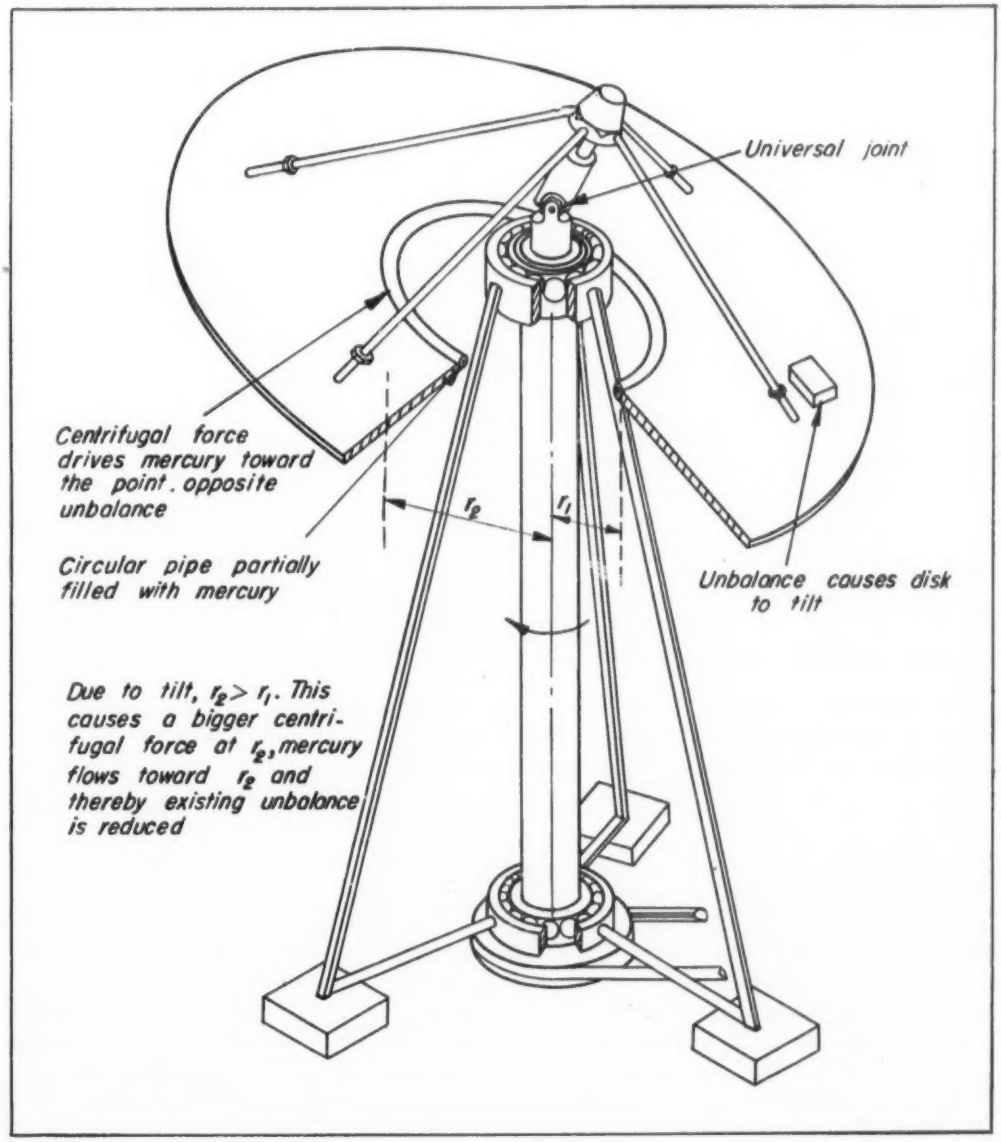


Fig. 9—Circular pipe partially filled with mercury provides automatic self balance for a rotating antenna

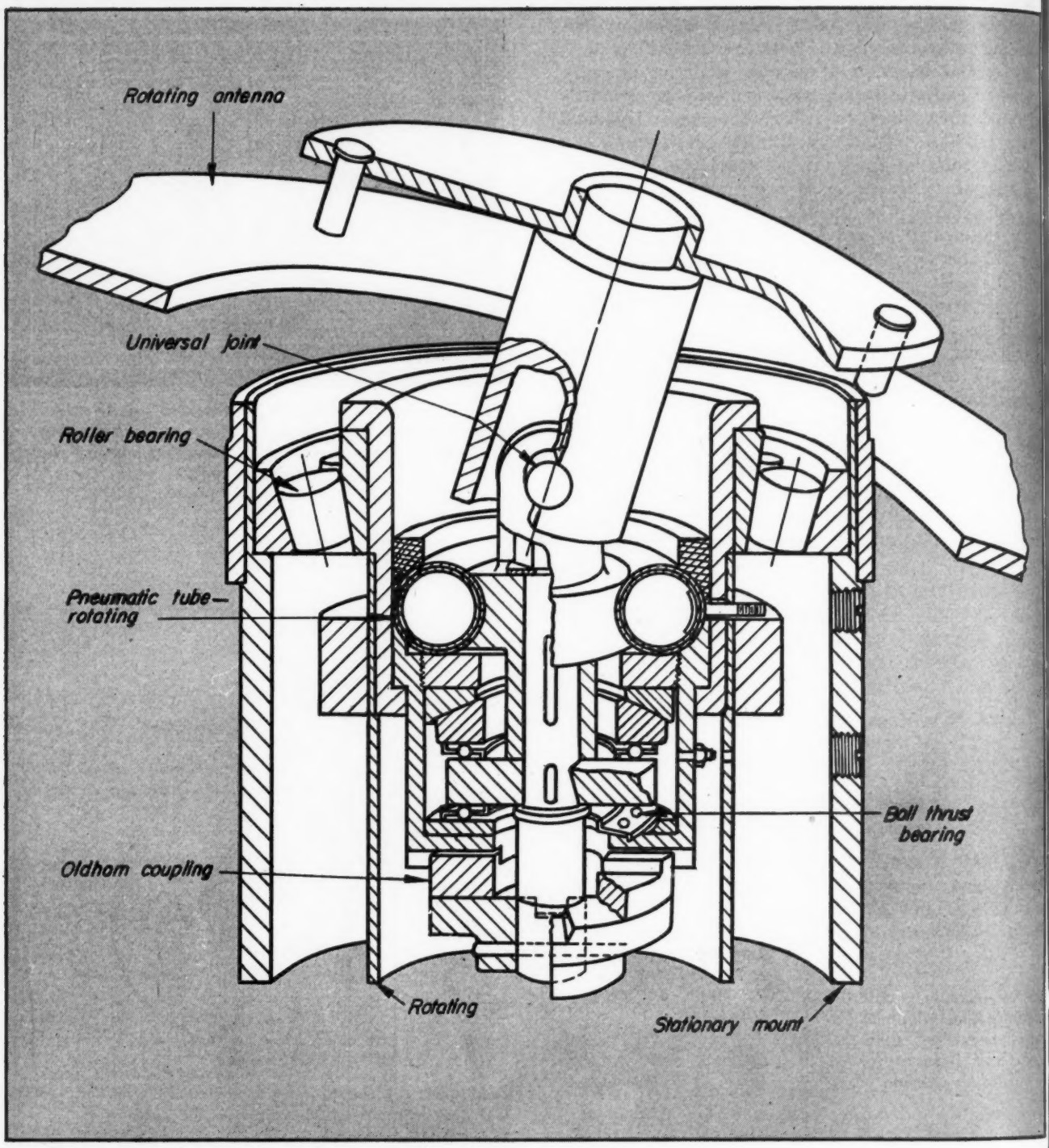


Fig. 11—Principle of the pneumatic tube is applied to this design for mounting a large rotating antenna. Tube permits antenna to "float" into balanced position at speeds above the critical

est eccentricity may cause them to do more harm than good. Devices of this nature include raceways, concentric with the shaft and filled with two or more rolling balls as in the balancing device shown in *Fig.* 8, circular pipes partially filled with mercury, *Fig.* 9, and a pair of large rings riding on a cone, *Fig.* 10.

The author has made a great number of tests with devices of the kind just described and considers them to be unreliable in most practical applications. At times they are surprisingly effective; at other times they prove to be utterly useless. The reason for this unreliability is believed to be, in part, the inability to maintain necessary perfect concentricity of the moving track, which may be easily disturbed.

ANTENNA MOUNTS: The design of large rotating antennas has necessitated a thorough study of the foregoing principles. A result of this study is the development of two designs. The first uses rolling balls to support the weight of the antenna without restraining its lateral motion, an Oldham coupling to transmit the torque, and a pneumatic tube to center the floating antenna wheel. A universal joint is added to eliminate any gyroscopic forces of the antenna, *Fig.* 11. In order to pass through the critical speed

without excessive vibrations, a hydraulic dampening device can be added, *Fig.* 12.

The second mount uses an electromagnetic chuck which clamps the antenna rigidly to the shaft at low speeds and releases the antenna so that it may float on the rubber tube at high speeds, *Fig.* 1.

The rotating antenna is supported by the ball thrust bearing and is free to move angularly because of the universal joint. Lateral freedom is permitted by the Oldham coupling if the electromagnetic clutch is energized.

Model tests have shown that structures with considerable unbalance can be rotated at high speeds without trouble if these principles are used. Low air pressure in the rubber tube is necessary for low critical speed. However, air pressure cannot be reduced below the point where rolling friction of the steel balls or other horizontal forces, tending to displace the rotating structure from its axis of rotation, cannot be overcome.

DYNAMIC VIBRATION ABSORBER: A method of eliminating undesirable vibration is to add to the existing vibrating force another of the same frequency and amplitude but of opposite phase, so that the two vibrating forces cancel each other. This can be achieved by adding a spring and mass vibration system which is resonant at the operating frequency. Discussion and analysis of the application of this principle to a rotating antenna follows.

Referring to *Fig.* 13, the dynamic vibration absorber consists of a stationary mass m_2 supported by springs k_2 which are attached to the outer race of a ball bearing mounted on the rotating shaft. How the absorber is applied to a rotating antenna is shown in *Fig.* 13.

For the antenna, whose mass is m_1, the equation of motion is

Acceleration force + elastic forces = vibrating force

or

$$m_1\frac{d^2x_1}{dt^2}+k_1x_1-k_2(x_2-x_1)=P_o\sin\omega t \quad \ldots\ldots (6)$$

where x_1 = deflection of mass m_1 in relation to center line, inches; k_1 = stiffness of support for mass m_1 in lateral direction, pounds per inch; x_2 = deflection of mass m_2 in relation to m_1; k_2 = stiffness of absorber springs in lateral direction, pounds per inch; P_0 = amplitude of vibrating force = $m_1e\omega^2$ pounds; t = time, seconds; e = eccentricity of m_1.

In like manner the equation of motion of mass m_2 is

Acceleration force + elastic force = 0 .

or

$$m_2\frac{d^2x_2}{dt^2}+k_2(x_2-x_1)=O \quad \ldots\ldots (7)$$

The steady-state solutions of Equations 6 and 7 are of the form $x_1 = a_1 \sin \omega t$ and $x_2 = a_2 \sin \omega t$. Substituting these values in Equations 6 and 7 and dividing throughout by $\sin \omega t$,

$$-m_1a_1\omega^2+k_1a_1-k_2(a_2-a_1)=P_o \quad \ldots\ldots (8)$$

$$-m_2a_2\omega^2+k_2(a_2-a_1)=O \quad \ldots\ldots (9)$$

Collecting terms for a_1 and a_2

$$(k_1+k_2-m_1\omega^2)a_1-k_2a_2=P_o \quad \ldots\ldots (10)$$

$$-k_2a_1+(k_2-m_2\omega^2)a_2=O \quad \ldots\ldots (11)$$

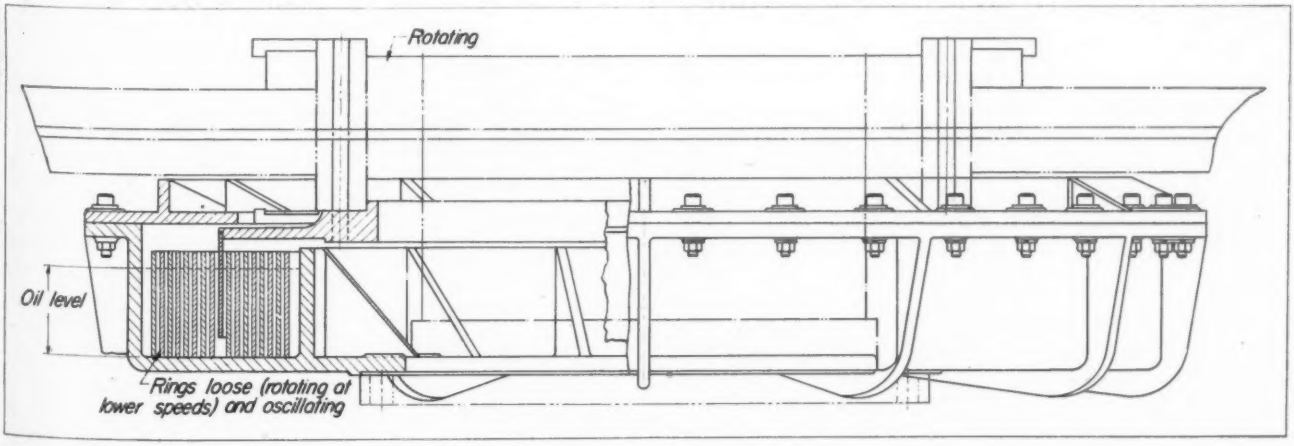
Solving Equations 10 and 11 simultaneously for a_1 and a_2 which are the amplitudes of x_1 and x_2,

$$a_1=\frac{(k_2-m_2\omega^2)P_o}{(k_2-m_2\omega^2)(k_1+k_2-m_1\omega^2)-k_2^2} \quad \ldots\ldots (12)$$

$$a_2=\frac{k_2P_o}{(k_2-m_2\omega^2)(k_1+k_2-m_1\omega^2)-k_2^2} \quad \ldots\ldots (13)$$

With proper selection of m_2 and k_2 the designer

Fig. 12—Hydraulic dampening device permits rotating antenna to pass through the critical without excessive vibration



can make $k_2/m_2 = \omega^2$ so that the numerators of Equation 12 becomes zero and $a_1 = 0$. Substituting in Equation 13, $a_2 = -P_0/k_2$. Therefore $x_1 = 0$ and $x_2 = -(P_0/k_2) \sin \omega t = -(m_1 e\omega^2/k_2) \sin \omega t = -(m_1/m_2)\, e \sin \omega t$.

It is evident that when $k_2/m_2 = \omega^2$ the antenna will not vibrate at all ($x_1 = 0$). The added weight, m_2 does vibrate, however, transmitting a force to the main shaft exactly equal in frequency and amplitude to the vibrating force caused by existing unbalance, but 180 degrees out of phase. The center of gravity of the stationary mass m_2 rotates at the same speed and in the same direction as m_1 but 180 degrees behind the center of gravity of m_1.

A limitation of this design is that it functions well at one speed only, the speed for which the dynamic vibration absorber is tuned, $\omega = \sqrt{k_2/m_2}$. In a constant-speed machine this limitation, of course, has no significance provided the rotating part can be quickly brought up to speed and quickly braked to rest.

ACKNOWLEDGMENT: The mathematical analysis in this article was performed with the assistance of Mr. T. Searle, of the engineering research unit.

REFERENCE

J. P. Den Hartog—*Mechanical Vibrations*, McGraw-Hill Book Co., Inc., New York.

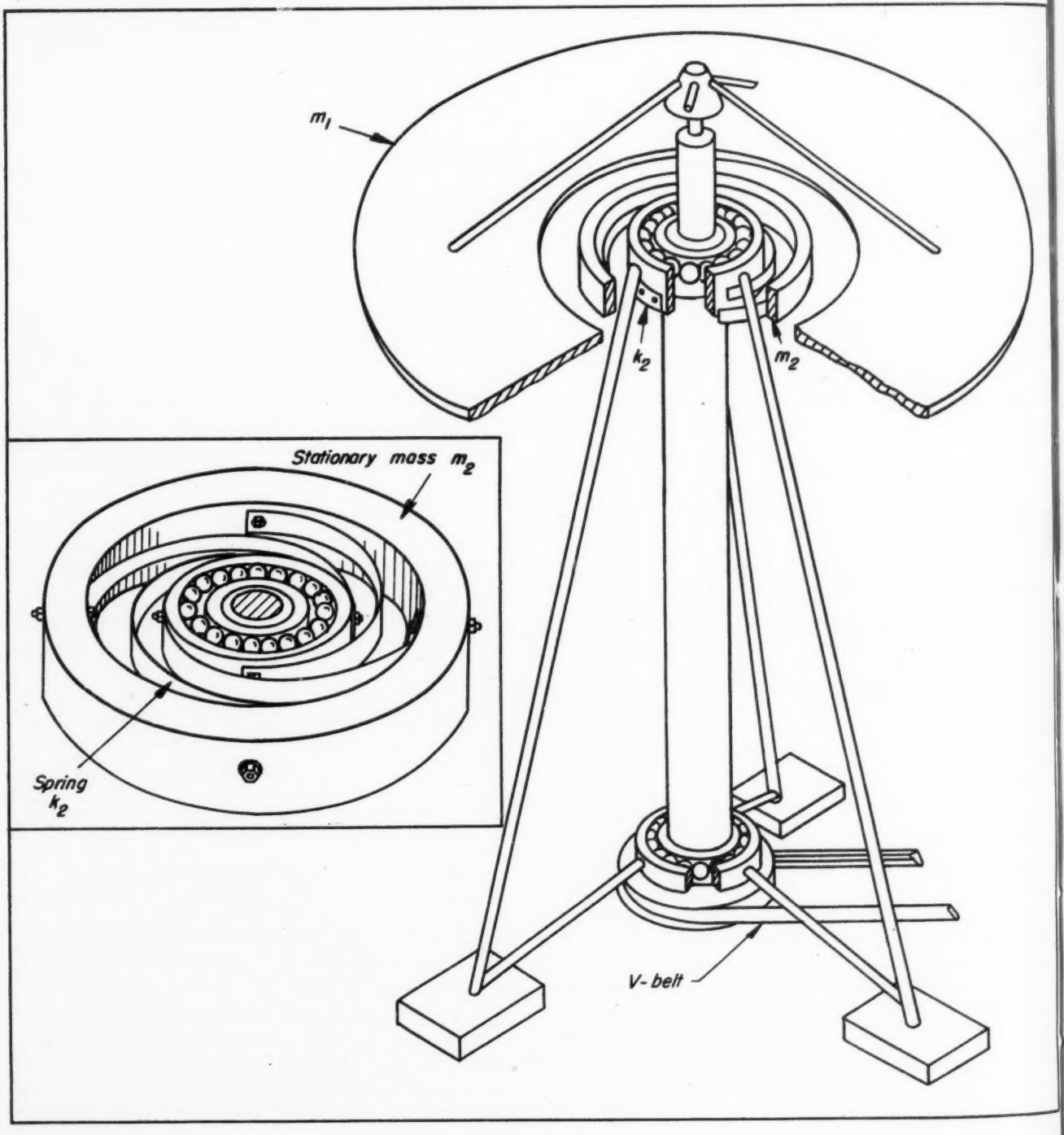
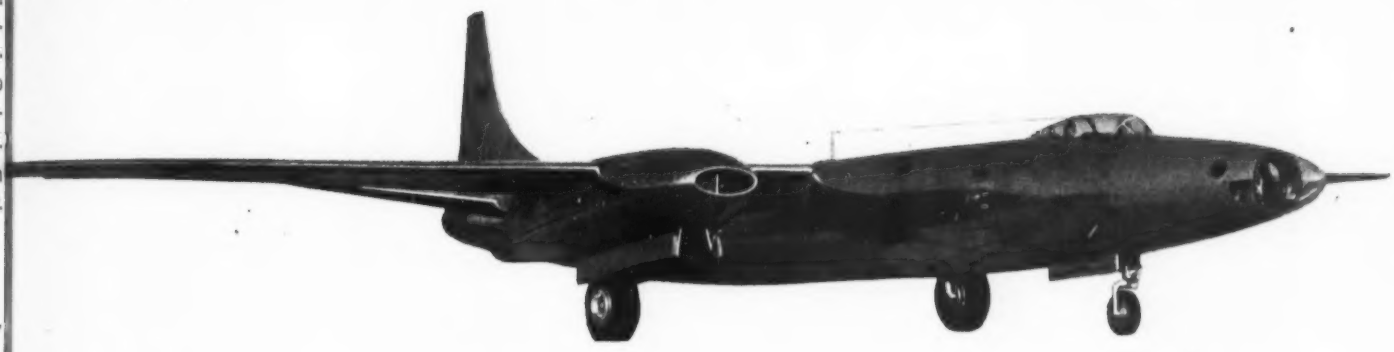


Fig. 13—Application of dynamic vibration absorber to a high-speed rotating antenna. Absorber (inset) is a spring and mass system tuned to the speed of operation, which provides a periodic force counter to the unbalance



Finishes For Machine Parts

By Joseph Mazia

Metallurgist
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Ambler, Pa.

Factors Influencing Choice of Finish

Life of part — *Cost of part*

Function of part — *Service of part*

Composition of part

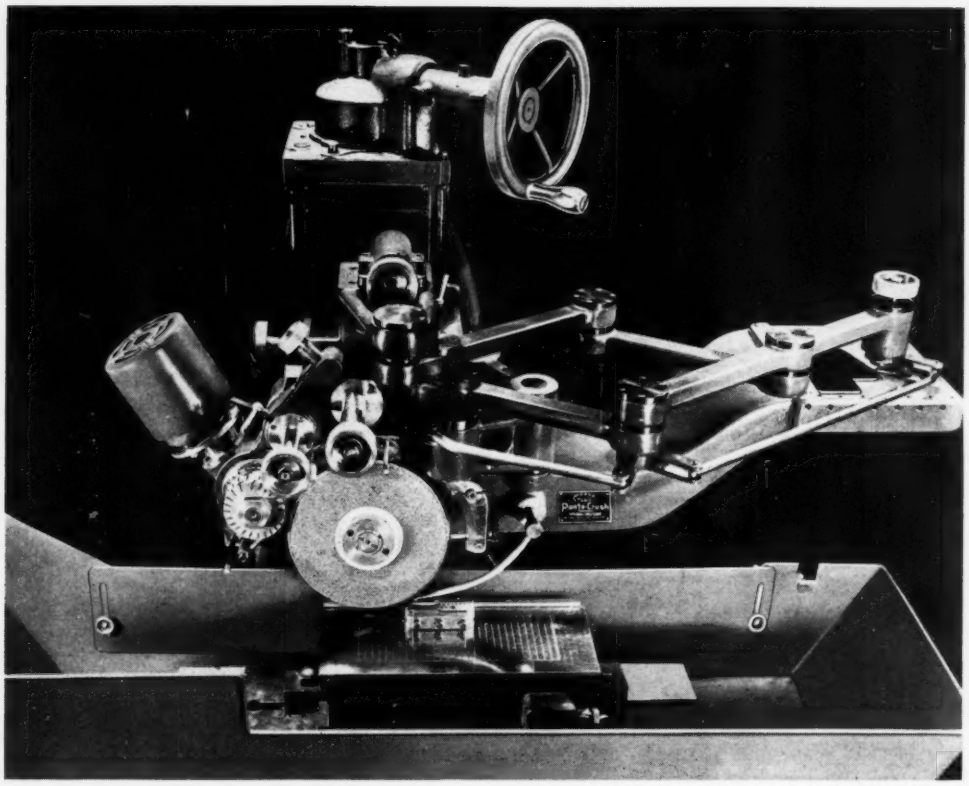
DESIGNERS, with the possible exception of those in the automotive and home appliance fields, have often tended to ignore the importance of sound finish engineering. Good functional design, proper selection of material, accurate machining, precise heat treatment and faultless assembly all receive the most careful consideration. Finishing, on the other hand, is often either ignored completely or included as an afterthought in a blueprint note saying, "Paint, slush with oil, or cadmium plate." The fallacy of this type of practice is illustrated by the following case histories:

THIS ARTICLE introduces a series on the subject of finishes for machine parts. Subsequent discussions will cover in detail properties of finishes and the design of parts to which they are to the applied. Topics to be covered in forthcoming issues will include organic coatings, plating and chemical conversion coatings

A manufacturer of hammer mills for crushing ores or chemicals sold a large number of mills to a chemical manufacturer who intended to use them for milling fused alkalis. Although the mills were painted with a high-grade machinery paint, within several weeks of service most of the paint was gone owing to attack by alkali; the machines looked like antiques and the chemical manufacturer, who prided himself on running a model factory, registered a complaint. The mill manufacturer then consulted a finish engineer who informed him that he should have used an alkali-resistant paint of the chlorinated-rubber type instead of a pigmented oleo-resinous varnish.

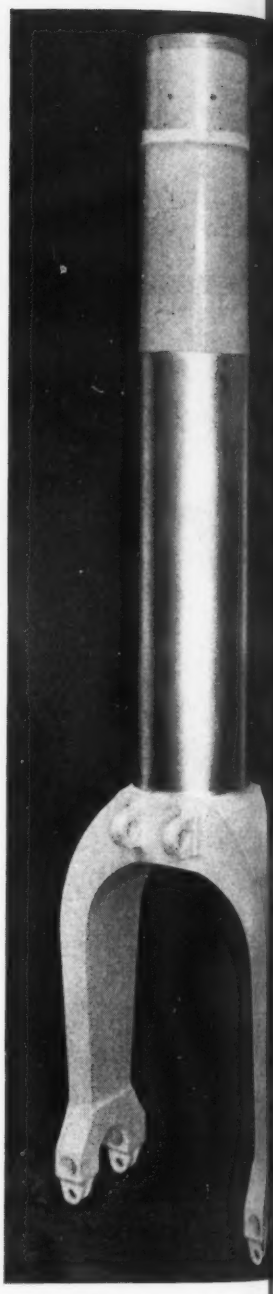
A manufacturer of precision instruments received a complaint from a customer that certain internal parts of a mechanism were failing to function properly owing to corrosion. Knowing that he had had the parts cadmium plated, the manufacturer was reluctant to believe that they were rusting in the

Top—Modern jet bomber makes use of virtually all representative finishes. Chemical conversion coatings on ordnance parts, anodizing of aluminum, porcelain enameling of jet tail pipe, metal sputtering of instrument parts, and enamels on interior parts



Photo, courtesy Moore Special Tool Co. Inc.

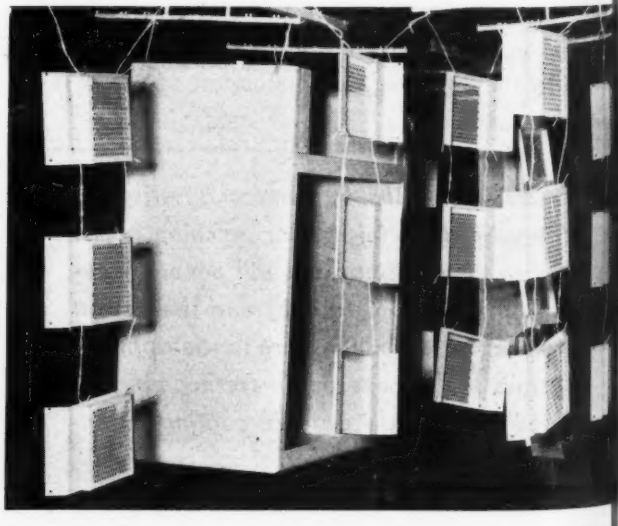
Moore grinding-wheel dresser, above, makes extensive use of black oxide finish on exposed parts



Chromium plating on aluminum, right, is used to reduce wear on hydraulic landing-gear struts

Photo, courtesy Van der H

Refrigerator shells, below, shown on the paint spray line, are enameled over a zinc-iron phosphate chemical conversion coating



short time that they had been in service. He called in a consultant to study the situation. It was found that the parts had indeed corroded and the fault lay in two factors: First, no thickness had been specified for the cadmium plate and it was actually found to be only 0.00005-inch; second, the chemical fumes emanating from phenolic plastic parts in the mechanism had rapidly attacked what little cadmium there was, permitting corrosion of the steel.

A manufacturer of metal kitchen equipment was threatened with the loss of the lion's share of his business because of paint failures and corrosion in the field. All of the complaints followed the same pattern: In the course of normal handling, a nick or cut developed in the paint film; rust reared its ugly head in the damaged area and soon spread like a cancer under the paint film, dislodging the paint and making the units a sorry sight to behold. The manufacturer made three false starts before the solution was found. First, he changed the paint system, although the system he had been using was giving good service on a competitor's equipment. Second, he installed an alkali cleaning system before his paint line in the belief that his cleaning was at fault. When this aggravated the situation he bought a vapor degreaser for preparing the surfaces for painting. Although this did not solve his problem of underfilm corrosion and undercutting of the paint film he was on the right track—his treatment prior to painting was at fault. When he finally consulted a specialist he was informed that he would have to go a step beyond removing grease, oil and other dirt, which was being done quite efficiently by his alkali washer or his vapor degreaser. He would have to apply a phosphate coating to the precleaned steel surface. This type of crystalline coating, be-

ing stable and insoluble, would tend to bind the paint tightly and prevent galvanic acceleration of the corrosion of the base metal.

These examples illustrate the economic importance of good finish engineering. The protective finish on machines can be compared in importance with the skin on our bodies. In an inanimate object beauty may be only "skin deep" but the protective value must go deeper if it is to succeed in its mission. Automotive chromium finish may be taken as an example of this for the finish contains only from 0.00001 to 0.00002-inch of chromium on the surface. In this case the beauty is indeed only "skin deep" for the protective value depends on an underlying 0.001-inch combined thickness of nickel and copper deposits.

Corrosion Protection

Principal reason for applying a finish to a metal surface is to protect the metal structure from corrosion. Assuredly, other reasons are valid and impose their limitations on the primary one. These include coloring or appearance, abrasion and wear resistance, and specialized applications such as sound deadening and electrical insulation. Since corrosion of metals is the main target of the finisher and is the prime destroyer of mechanical properties, it follows that good finishing practice is an important part of sound engineering design. Recognition of this fact has been in the dawn stage of its development during the past ten years. This recognition has led to the healthful and economically profitable practice of having corrosion engineers and other protective finishing experts work hand in hand with designers from the time of conception of new equipment.

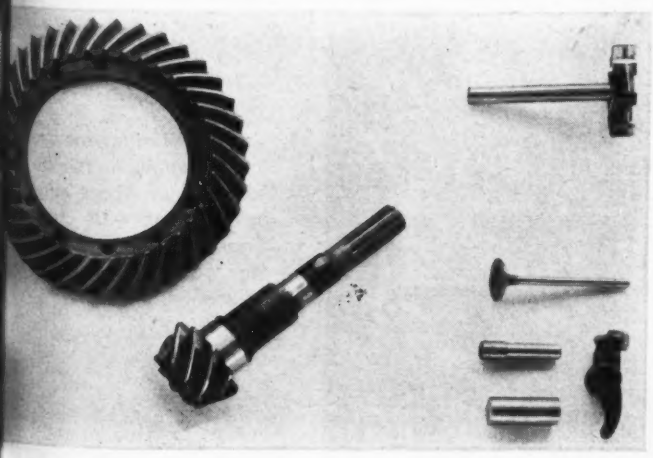
Important factors to be considered in the choice of finishes are: The function of the part, the alloy of which it is fabricated, the environment in which it is expected to serve, allowable cost for finishing, finishing processes available to the manufacturer, life expectancy of the part, and the condition of the part when it is received by the finishing shop.

Once these factors have been considered the engineer must choose a finish from among the following general categories:

1. Rust preventive compounds; slushing oils
2. Chemical conversion coatings; manganese-iron phosphate on steel or chromate-phosphate on aluminum alloys
3. Electrochemical finishes
   a. Anodic or reverse current types; electropolishing, anodizing of aluminum, magnesium or zinc alloys
   b. Electrodeposited coatings, cathodic or direct current processes; zinc, copper, nickel or chromium plating
4. Hot-dip metal coatings; Terne plate, galvanizing, tin plating
5. Special metal coatings
   a. Immersion, or electroless deposits; Cuprodine for copper on steel, Brenner-Riddel process for nickel on steel
   b. Metals evaporated in vacuum
   c. Metal sputtered in vacuum
   d. Iron or nickel deposited from carbonyl compounds
6. Sprayed metal or metallized coatings; Schoop process, Schori process
7. Diffusion coatings; Sherardizing for zinc on steel, Ihrigizing for silicon impregnation of steel
8. Vitreous enamels
9. Organic finishes; paints, lacquers, varnishes and related materials.

This list is only a bare outline of the finishing field as it exists today. Yet it illustrates the vastness of the field and should give hope to the harried engineer that somewhere in this maze of applied science is the precise process to fit his needs whether

Wear and corrosion resistance of machine parts is increased by manganese-iron chemical conversion coatings



Forgings and other aluminum aircraft parts are protected by electrochemically or chemically applied coatings

the finish be applied by a putty knife or sputtered from a live electrode in a high vacuum.

Proper preparation of metal surfaces prior to application of a finish is a matter of considerable importance. To paraphrase Dr. Oliver P. Watts, pioneer scientist in the plating field: Good electroplating is 99 per cent good cleaning and only 1 per cent electrodeposition. The same type of reasoning holds for organic finishes as well. If mortality tables were available for organic finishes on metals over 50 per cent of the premature failures would be found due to improper pretreatment. No matter how well conceived and well formulated a paint system is, if it is applied to a substrate which is actively corrodible or which contains foreign matter chemically or physically antagonistic to paint adhesion, the system will break down and allow the structure to deteriorate.

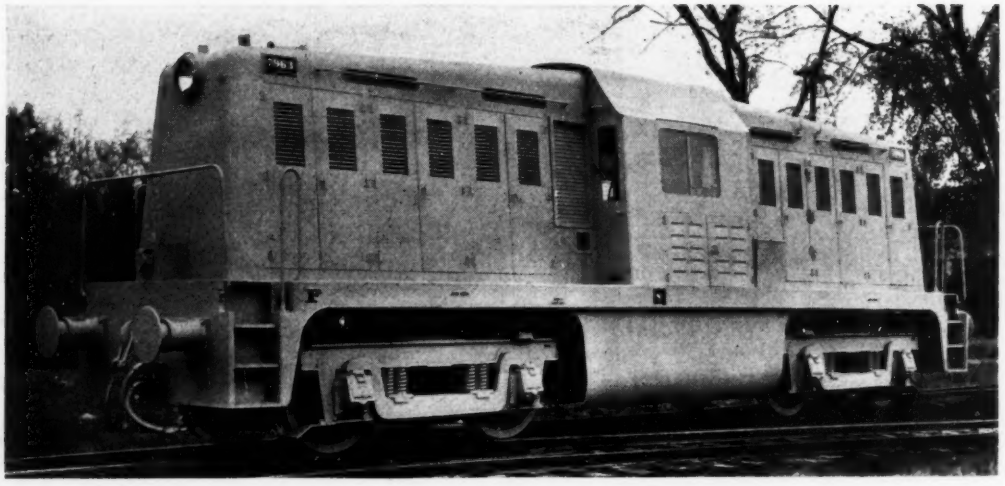
Precleaning Important

Regardless of whether it is desired to prepare a metal surface for chemical conversion coating, electrodeposition, anodic treatment, or even slushing with rust-preventive compound, it is mandatory that foreign material, generally referred to as "dirt", be removed. Under the heading of dirt is included grease, oil, solder flux, brazing flux, welding slag, grinding compound, polishing or buffing residues, heat treating salts, perspiration, fingerprints, metal grindings or filings, chalk and crayon markings and incidental carbonaceous and siliceous materials. For proper preparation for painting it is necessary to go a step further and remove harmful residues from certain methods of cleaning. These include corrosion stimulators such as chlorides and sulfates, alkaline residues, most water-soluble, water-adsorbing substances, lint and fingerprint residues.

Where heavy films of grease and oil must be removed, one of several methods or combinations of them is generally used. These include: Solvent degreasing by immersion or spraying of the parts in hydrocarbon solvents; vapor degreasing with chlorinated hydrocarbons like trichlorethylene or perchlorethylene; emulsifiable solvent cleaning with hydrocarbon solvents containing special soaps or synthetic emulsifying agents; emulsion cleaning with organic solvents dispersed in water by the use of special soaps or synthetic emulsifying agents; alkaline cleaning with water solutions of alkaline salts; and acid cleaning, usually with solutions of orthophosphoric acid.

The "fifth column" of paint failure is made up of a number of factors. Some of these are residual from the fabricating operations and some from the cleaning. Others are inherent in the paint system. Detailed discussion of the last two factors is beyond the scope of this article but they include unwise choice of paint system, too thin or too thick a coating, "holidays" or discontinuities in the coating, and improper curing of the finish. It should be understood that proper pretreatment of the surface may partially or totally compensate for some of these factors but it should not be relied on to do so. Good pretreatment practice should be used as a component part of a totally good finishing scheme and not as a crutch for a bad paint job.

Organic coatings of the Wrinkle type are used to enhance appearance and to reduce light reflection



Organic finishes for use on equipment to be used out of doors must be selected with care. Coating must resist fading and abrasion as well as corrosion

MACHINE *Editorial* DESIGN

Engineering Staffs Should Be Maintained

Probable induction into the armed services is around the corner for many graduates of engineering colleges. The new selective service act gives draft boards the power of exemption for young men in certain categories whose continued activities in their occupations are essential to the safety and interests of the country. Whether the boards will recognize that engineeering graduates should be allowed to take positions in industry after graduation, however, is questionable.

To a great extent the decision of the boards necessarily will be based on the potential value of individuals to organizations capable of producing wartime commodities in case of need. It is therefore a matter of much concern to companies in this classification to insure they will not be faced with a shortage of personnel capable of making rapid progress within their engineering departments.

Such shortages in manpower might be obviated to a considerable extent if manufacturing companies could arrange to keep in closer touch with the colleges in their quest for additions to their staffs. The practice of certain of the larger companies in following this procedure is commendable and might to advantage be adopted by medium-sized and small concerns in general. Preliminary arrangements for full-time employment made between students and potential employers offer distinct possibilities in that the student could, particularly during vacation periods, be engaged by the company as part of his training course. Thus the student would be more qualified to serve his company effectively upon graduation and the employer, on the other hand, should be more assured of being able to add youthful incoming personnel to his engineering staff.

Directory of Materials

Because the engineer responsible for design necessarily must have at his finger tips the latest available information on both metallic and nonmetallic materials to assist him in selection and specification, MACHINE DESIGN is pleased to present in the current issue the fifteenth edition of its Directory of Materials. The up-to-date information included in the directory should serve as a readily available guide and will, it is hoped, considerably lighten the load on the designer under current conditions.

L. E. Jermy

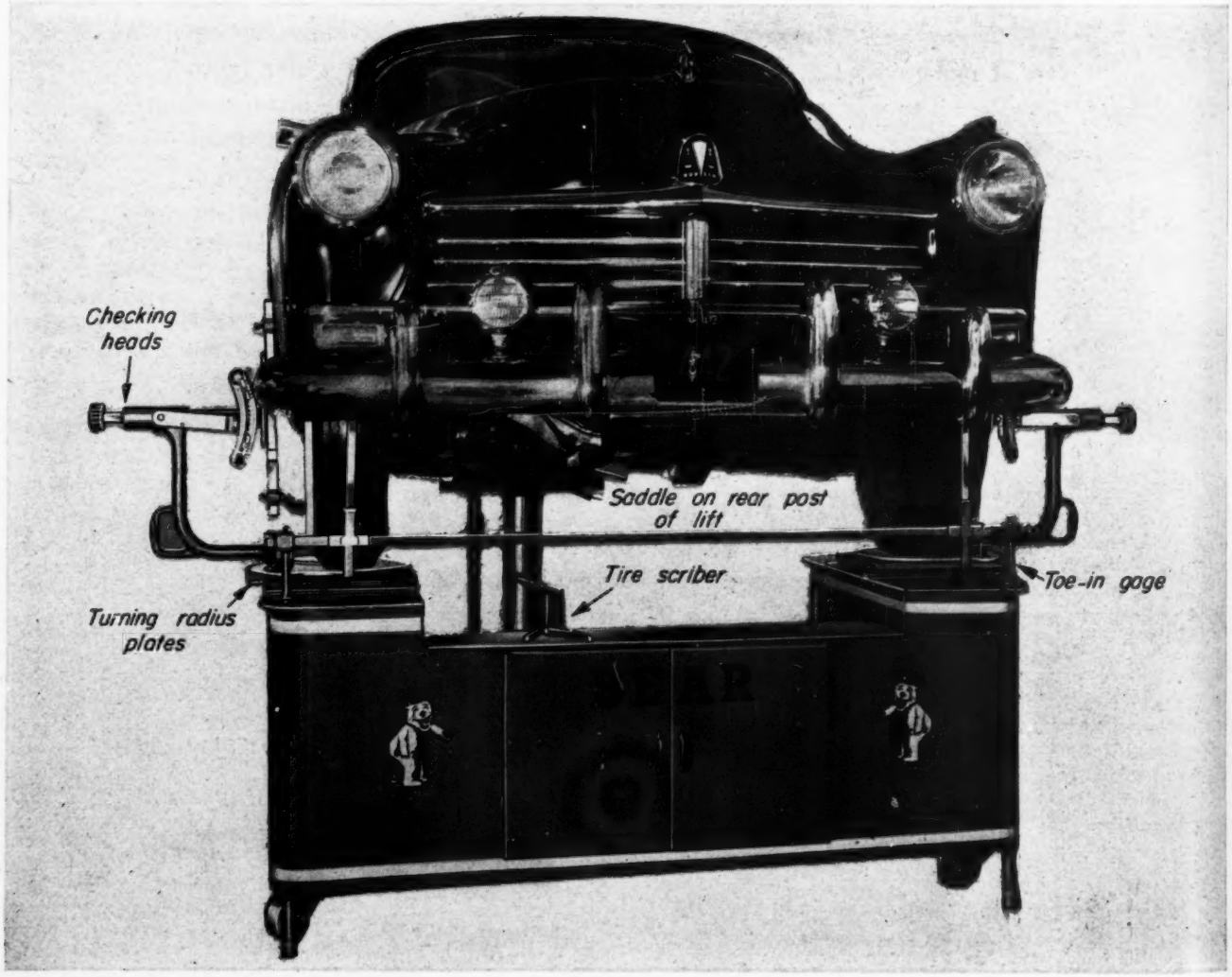
DESIGNS OF THE MONTH

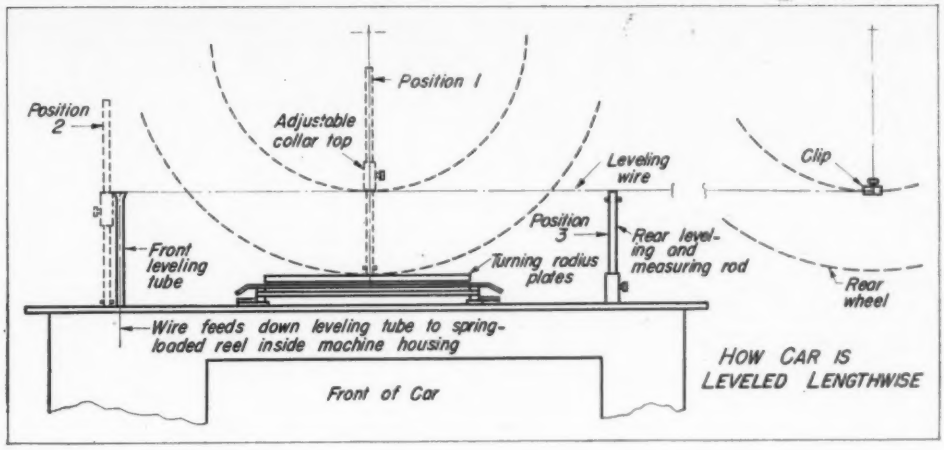
Machine Facilitates Checking of Automobile Front-End Alignment

THE machine shown in the photograph below, known as the "Lift-Aliner", is designed to make front-end alignment checking on knee-action automobiles possible in conjunction with a twin-post service station lift. Alignment covers the checking of camber, caster, toe-in, turning radius, and steering action.

Framework of the machine is constructed of welded angle iron capable of supporting a concentrated load of 1500 pounds on each side. Angles forming the upper part of the frame carry the load and these in turn are carried by four vertical corner angles to which the casters are attached. The load is transferred from the casters to adjustable post supports during the locking and leveling procedure. With the front wheels of a car positioned and resting on the turning radius plates, leveling of the machine is accomplished by adjusting the four corner posts as shown in the sectional drawing, bottom right of next page.

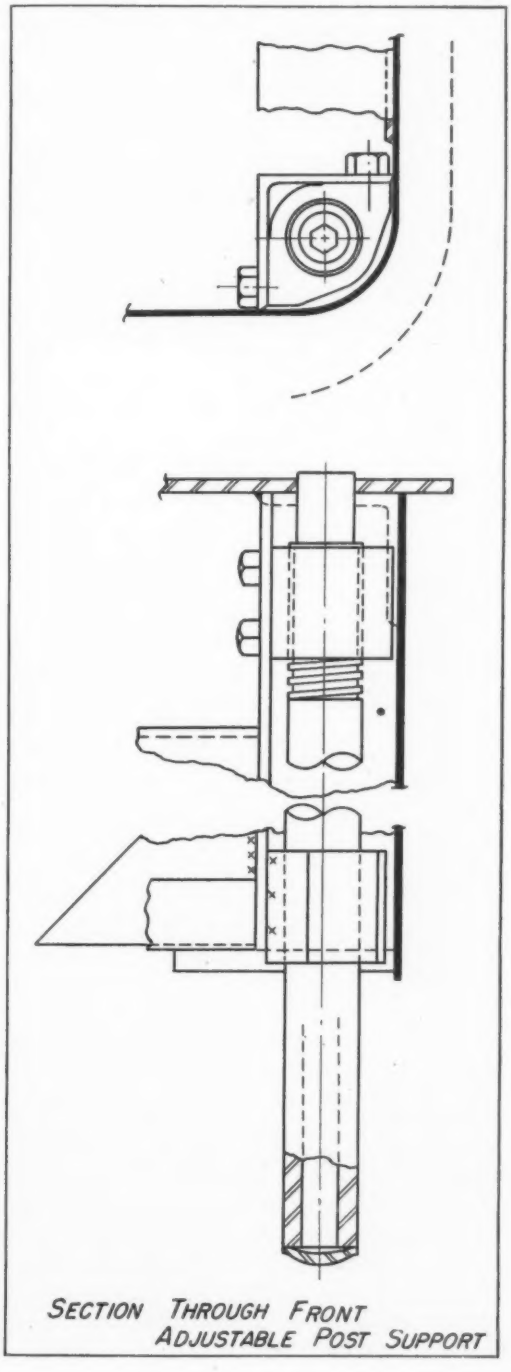
Leveling the car longitudinally is accomplished as follows (see drawing at top of next page): Height of the





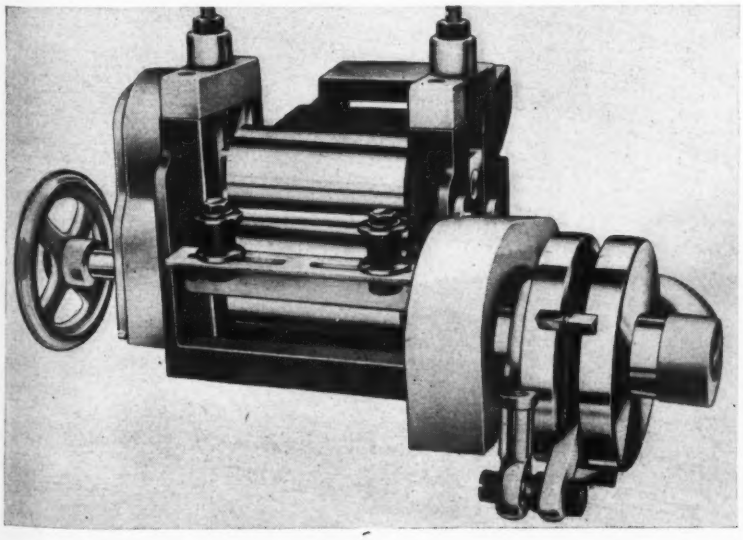
HOW CAR IS LEVELED LENGTHWISE

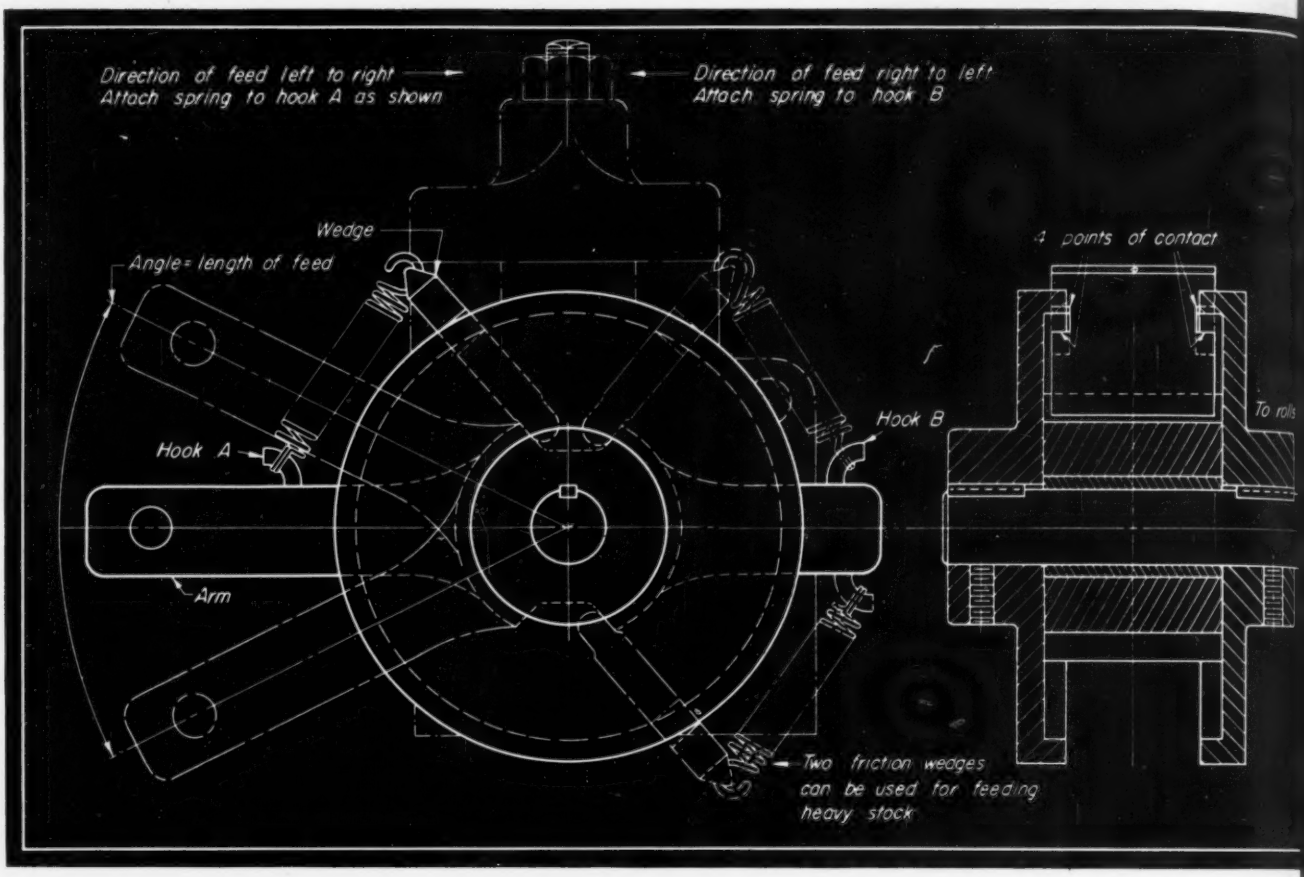
wheel rim above the turning-radius plates is measured by securing the top of the adjustable collar on the inverted leveling and measuring rod flush with the wheel rim (Position 1). Next, with the inverted measuring rod in Position 2, the front leveling tube is raised and secured by set screw so that its flared end is flush with the bottom of the adjustable collar. Finally, with the measuring rod in Position 3 (same height as the front leveling tube), the leveling wire is pulled out of the leveling tube and fastened with a clip to the lowest point of the rear-wheel rim. The rear leveling post of the machine is then raised or lowered until the leveling wire is flush with the top of the rear leveling rod. After the car has been leveled crosswise and lengthwise, checking and adjusting of camber, caster, etc., are effected by the use of special devices which fasten to the basic machine. Manufacturer: Bear Mfg. Co., Rock Island, Ill.


SECTION THROUGH FRONT ADJUSTABLE POST SUPPORT

Nonslip Feed by Simple Wedge Action

ELIMINATING the use of pawls and ratchets, the roll feed shown in the photograph below achieves nonslip, measured feed of strip stock in punch presses by simple wedge action. As the cross section drawing at the top of the following page shows,





an arm is mounted between two hardened steel disks, the arm being freely rotatable on the shaft, while the two disks are keyed and setscrewed to the shaft. Annular flanges extend inward at the peripheries of each disk, fitting into side cutouts of a wedge which rides between the disks. The lower end of the wedge rests in a cutout of the arm hub, while the upper end is linked to the arm by a coil spring.

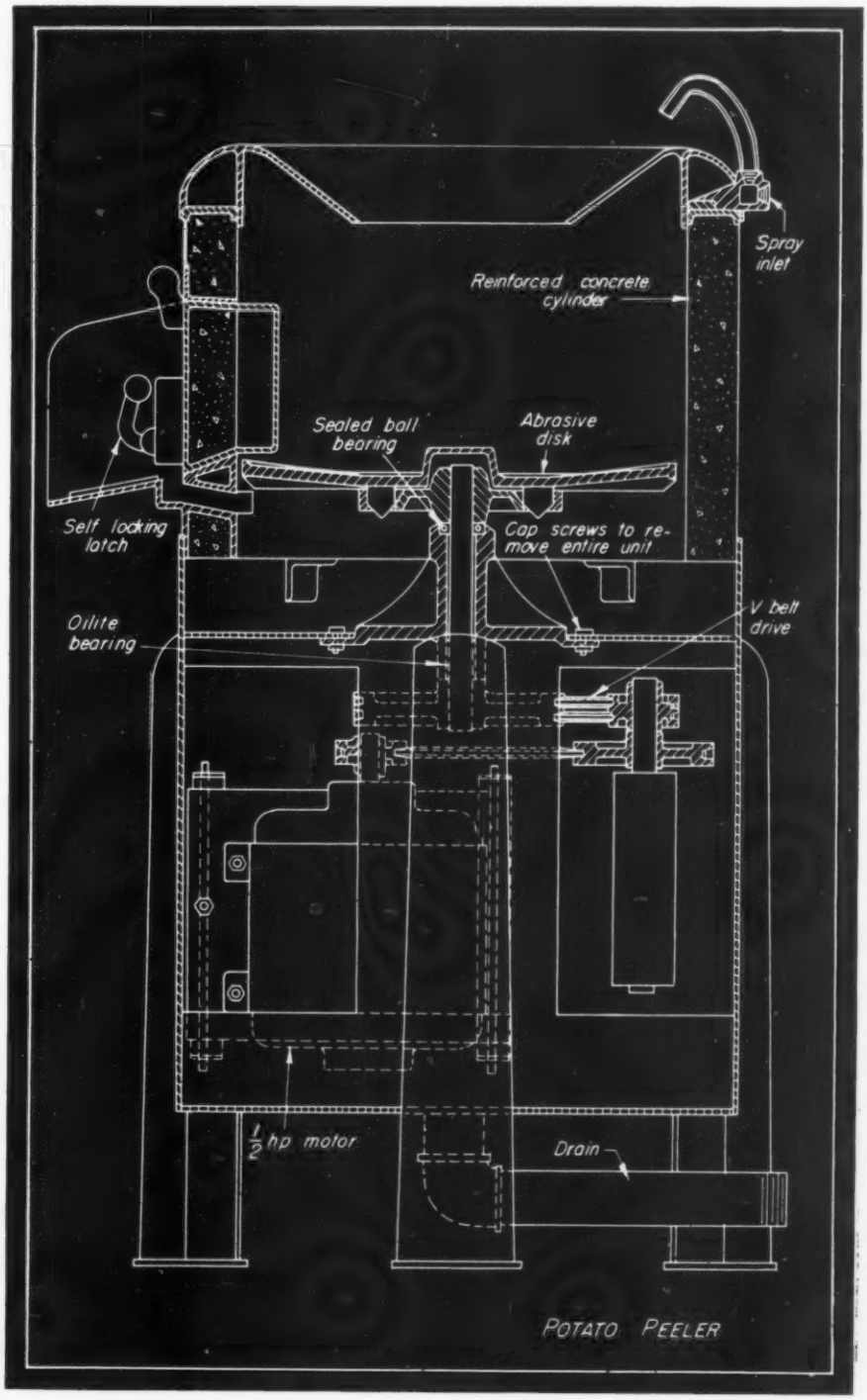
With the wedge positioned as shown in the drawing, when the arm is turned clockwise on the shaft, pressure is exerted by the cutout wall of the hub on the lower end of the wedge. This action effectively clamps the edges of the wedge cutouts against the annular flanges of the disks and the disks rotate in unison with the arm. Oil or grease does not affect the nonslip action. Upon return stroke of the arm, pressure is relieved at the lower end of the wedge and, pulled by the spring, the wedge slides freely around the disk periphery.

To reverse the direction of feed, it is only necessary to transfer the spring end from hook *A* on the arm to hook *B*. If a stronger feed action is required, another wedge can be used located 180 degrees from the first one. Friction disks and strip-feeding rolls are steel, hardened and ground; bearings employed are hard bronze. Manufacturer: Roll Feeds Corp., Pawtucket, R. I.

Potato and Vegetable Peeler

AN INTERESTING illustration of how modern clean-line styling can enhance the appearance and attractiveness of machines is afforded by the potato and vegetable peelers here pictured. The model shown at the bottom of the preceding page supersedes that shown below. By rearranging the drive components, they have been fitted into a base which blends with the top unit and saves floor space. Newest model has case of stainless-clad steel which will not corrode or tarnish and provides a highly attractive finish.

Peeling action is effected by spinning the vegetables around in a cylindrical chamber having abrasive side walls and an abrasive rotating disk. Chamber cylinder is composed of a special mixture of cement and sharp particles of quartz. The disk is cast iron, its top surface being completely covered with carborundum which is fused into the cast iron during casting. As the cross section drawing, right, shows, drive for the disk is by multiple V-belt and slack takeup is effected by mounting the motor on an adjustable, hinged bracket. Door of the peeling chamber, of cast aluminum, is equipped with an automatic, positive lock. Trap in front of door catches any water seeping through door and returns it to peeling chamber for drainage to sewer. Since these machines are not mass produced, the aluminum hopper covers are spun to shape rather than press formed. For the same reason arc welding is used for fabricating the lower skirt and legs. In the new model, the spray pipe used to wash off peelings as they are removed, has been raised above the top edge of the peeler to prevent back siphonage to the supply main. Manufacturer: G. S. Blakeslee & Co., Chicago 50.



Applications

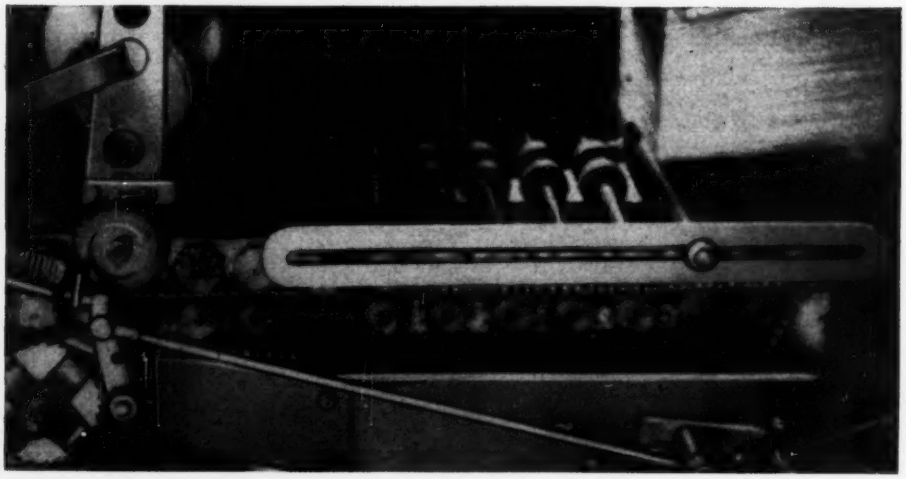
of engineering parts, materials and processes

Increases Soldering Speed

USE of induction soldering has resulted in a 280 per cent increase in the production of tractor radiators. Tocco radiator induction soldering machine, seen at right, produces uniform joints using a minimum amount of material.

Reduces Material Damage

COMBINATION of corrosion resistance, light weight and smooth nonabrasive finish of Durez is used to advantage in the thread tension pulleys, left above, used to maintain tension in rayon during weaving. The medium-impact plastic molding is mounted on deep-groove ball bearings and fitted directly to the spinning frame. Less drag and reduced breakage result in infrequent shutdowns and consequently high operating efficiencies of the mill.



Balanced Drive for Feeder

PAPER feed problem in the printing press, left, was solved by the use of Baldwin-Rex roller chain. Two rows of friction rolls are synchronously driven in opposite directions by means of double-strand chain which passes between and simultaneously engages sprockets coupled to each roll. Both rolls thus transmit positive drive to paper, reducing slip.

Intermittent Mechanisms

By Guy J. Talbourdet
Research Division
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Part II

MODIFYING effects of eccentrics, racks and links are discussed on this and the following pages, continuing the analysis of intermittent variable-speed mechanisms, the principles of which were introduced in last month's data sheet. Equations of motion for the output shaft are presented, and illustrated by curves showing typical performance.

B. Fixed Eccentric and Sliding Rack Control Mechanism

As shown in *Figs.* 9 and 10, the mechanism consists of a rack B which moves in slot C cut in disk or flywheel A, and which also is in mesh with pinion S_1 geared to the output shaft. For simplicity, the output shaft and the gear which meshes with S_1 are omitted from *Fig.* 10.

Motion of rack B is positively controlled by strap or connecting link D fastened to B by means of pin E. Strap D is also free to turn around a dead crank or stationary shaft F, fixed in the frame and off center with flywheel A.

The flywheel, rotating at uniform speed, through pin E constrains strap D to turn around stationary shaft F, and causes rack B not only to slide back and forth in slot C but also to roll on pinion S_1. Then, under the combined motion of rack B, a variable

This data sheet is based on a recent ASME paper.

Fig. 9—Perspective view of intermittent mechanism with fixed eccentric and sliding rack control

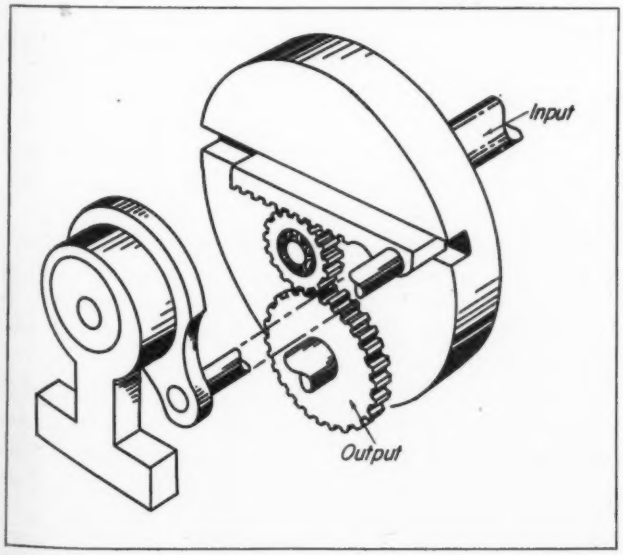
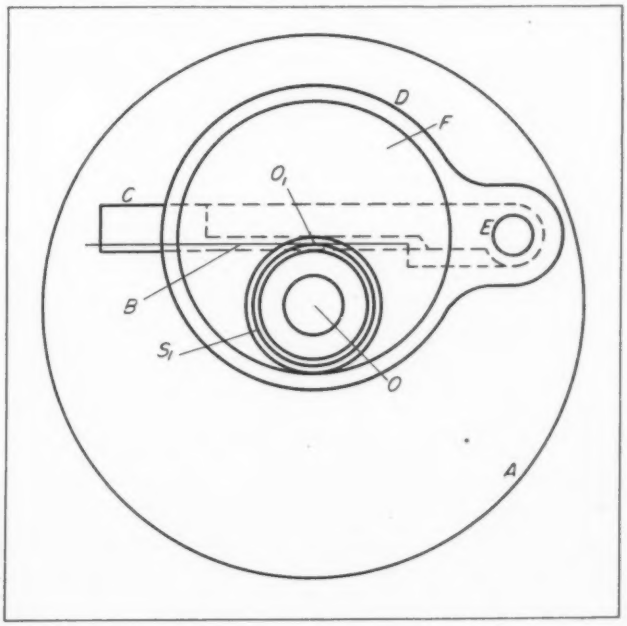


Fig. 10—Schematic diagram of intermittent mechanism with fixed eccentric and sliding rack control



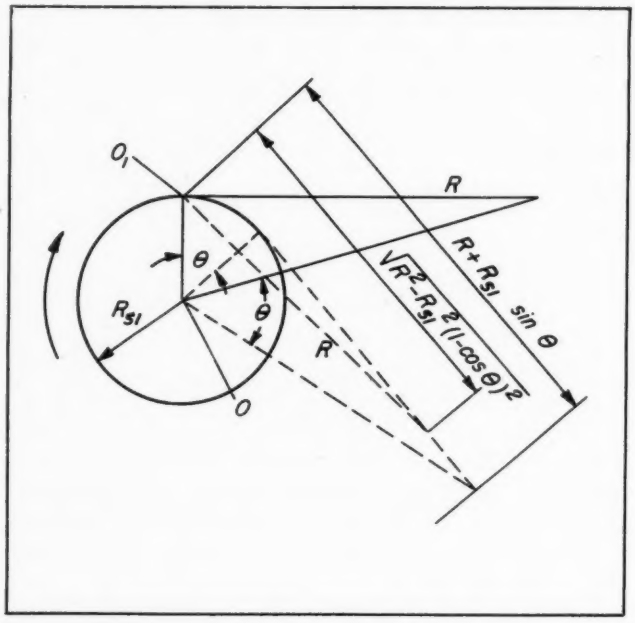


Fig. 11—Geometry of the sliding rack and fixed eccentric control mechanism of Figs. 9 and 10

speed motion is imparted to output pinion S_1.

To obtain a condition of zero velocity and zero acceleration at the start and at the end of the cycle of the output pinion, distance OO_1 between center of flywheel and center of stationary shaft must be equal to the pitch radius of the output pinion S_1.

ANALYSIS: When R is the length of connecting link, inches, and all other symbols are the same as before, the geometrical conditions of *Fig.* 11 give the following:

Motion of Rack:

$$S_R = R + R_{s1}\sin\theta - \sqrt{R^2 - R_{s1}^2(1-\cos\theta)^2}$$

Differentiating with respect to time for velocity and again for acceleration

$$V_{sR} = R_{s1}\omega\left[\cos\theta + \frac{\sin\theta\,(1-\cos\theta)}{\sqrt{\frac{R^2}{R_{s1}^2} - (1-\cos\theta)^2}}\right]$$

$$a_{sR} = R_{s1}\omega^2\left\{\frac{-\sin\theta}{\sqrt{\frac{R^2}{R_{s1}^2} - (1-\cos\theta)^2}}\left[\sin^2\theta + \cos\theta\,(1-\cos\theta) + \frac{\sin^2\theta\,(1-\cos\theta)^2}{\frac{R^2}{R_{s1}^2} - (1-\cos\theta)^2}\right]\right\}$$

Motion of Output Pinion:

$$\theta_{s1} = \theta - \frac{S_R}{R_{s1}}$$

$$\omega_{s1} = \omega - \frac{V_{sR}}{R_{s1}}$$

$$\alpha_{s1} = -\frac{a_{sR}}{R_{s1}}$$

These equations indicate that for values $\theta = 0$ and $\theta = 2\pi$, $\omega_{s1} = 0$ and $\alpha_{s1} = 0$, which fulfills the conditions of zero acceleration at the start and zero deceleration at the end of the motion of the output pinion. This is illustrated in *Fig.* 15 where for values $R_{s1} = 1$ inch and $R = 6$ inches, the angular displacement, velocity, and acceleration of the output pinion have been plotted as a function of the angular motion of a flywheel rotating uniformly at the rate of one radian per second counterclockwise, to compare it with the output motion of the next device. Here, the curves of the motion of the output pinion are not symmetrical.

C. Simple External Planetary System and Fixed Eccentric Control Mechanism

This mechanism is a sequel to the sliding rack and fixed eccentric device just described. Here, the rack is replaced by an oscillating external gear segment to eliminate the sliding action of the rack, *Fig.* 12.

As shown in *Figs.* 12 and 13, it consists of an external gear segment B whose center is free to oscillate on pin C attached to disk or flywheel A. B is also in mesh with pinion S_1 fastened to output shaft. Through pin E the motion of gear segment B is positively controlled by a strap or link D, which is free to turn around a dead crank or stationary shaft F fixed in the frame and off-center with that of flywheel A.

The flywheel, rotating at uniform speed, through pin E constrains link D to rotate around stationary shaft F and to cause gear segment B to oscillate about center O_2 of pin C and also to roll on pinion S_1. Under the combined oscillating and rolling motions of gear B, a variable motion is imparted to output pinion S_1.

Fig. 13 shows the mechanism at its starting position when link D is normal to center line OO_1 and to line joining pins C and E. At that position, link D passes through the common pitch point of gear B and pinion S_1.

ANALYSIS: Referring to *Fig.* 14, the following notation applies to this design: M = center distance between pins C and E, inches; L = length of connecting link, inches; R = distance O_1O_2, inches; α = angle between M and centerline OO_2, degrees; θ_p = angular displacement of planet gear segment around

center O_2, degrees; ω_p = corresponding angular velocity, radians per second; and α_p = corresponding angular acceleration, radians per second^2, all other symbols being the same as before.

From the geometrical conditions of *Fig.* 14 the following equations may be derived:

Motion of planet gear segment:

$$\theta_p = \tan^{-1}\frac{R_o \sin\phi}{R_A - R_o\cos\phi} + \cos^{-1}\frac{D}{2M\sqrt{B}} - \alpha$$

$$\omega_p = \frac{d\theta_p}{dt} = R_o\omega\left[\frac{R_A\cos\phi - R_o}{B} - \frac{R_A\sin\phi\ (2-\frac{D}{B})}{\sqrt{4M^2B-D^2}}\right]$$

$$\alpha_p = \frac{d^2\theta_p}{dt^2} = -R_oR_A\omega^2\left\{\frac{1}{\sqrt{4M^2B-D^2}}\left[\frac{2R_AR_o\sin^2\phi}{B}\left(\frac{D}{B}-1\right)\right.\right.$$
$$\left.+\left(2-\frac{D}{B}\right)\left(\cos\phi - \frac{2R_AR_o\sin^2\phi(2M^2-D)}{4M^2B-D^2}\right)\right]$$
$$\left.+\frac{\sin\phi}{B}\left[\frac{2R_o(R_A\cos\phi - R_o)}{B}+1\right]\right\}$$

where $R_A = R_{s1} + R_p$; $\phi = \theta - \alpha$; $K = M^2 + R_A{}^2 + R_0{}^2 - L^2$; $B = R_A{}^2 + R_0{}^2 - 2R_AR_0\cos\phi$; $D = K - 2R_AR_0\cos\phi$. Also,

$$R = \sqrt{R_A{}^2 + R_0{}^2 - 2R_AR_0\cos(\theta-\alpha)}$$

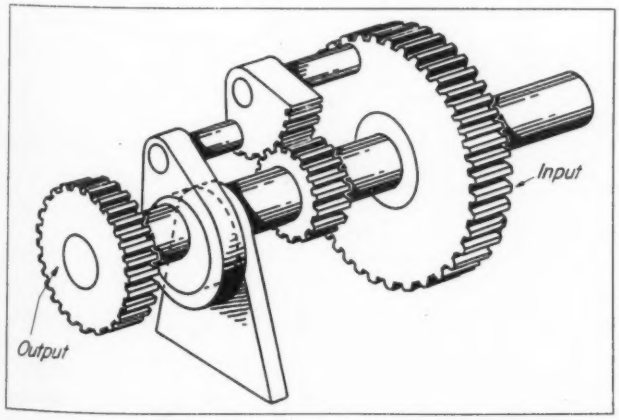
Motion of Output Pinion:

$$\theta_{s1} = \theta - \frac{R_p}{R_{s1}}\theta_p$$

$$\omega_{s1} = \omega - \frac{R_p}{R_{s1}}\omega_p$$

$$\alpha_{s1} = -\frac{R_o}{R_{s1}}\alpha_p$$

Fig. 12—Perspective view of simple external planetary system with fixed eccentric control



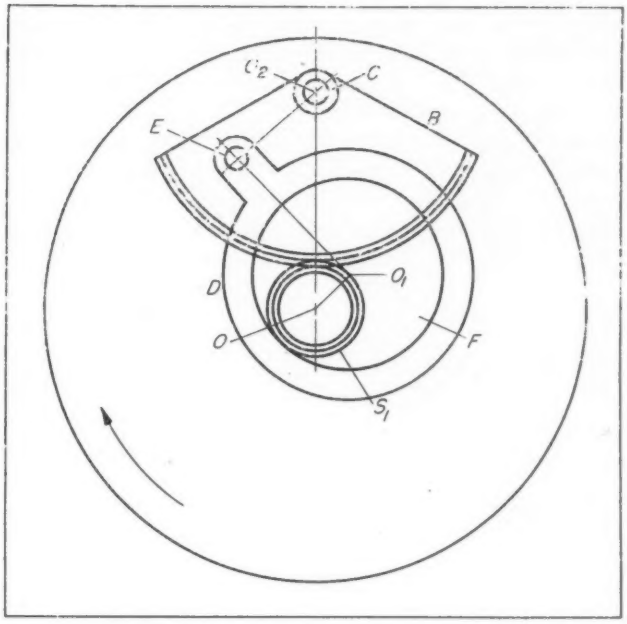
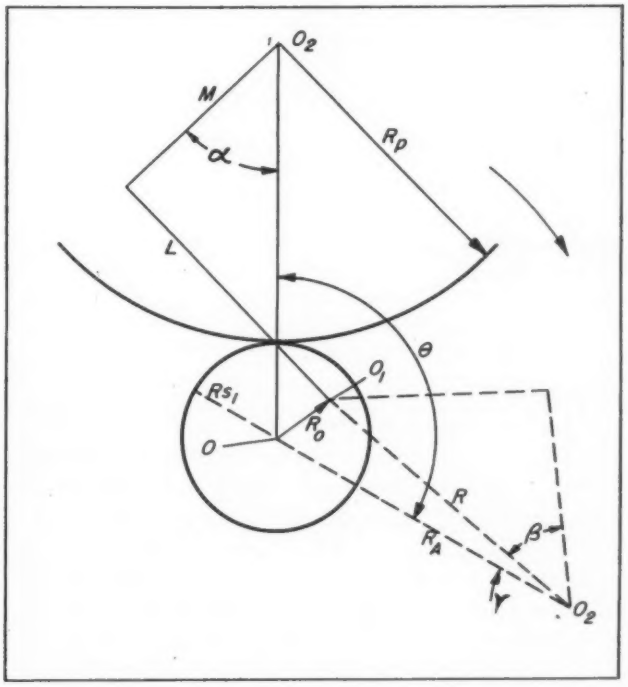


Fig. 13—Schematic diagram of simple external planetary system with fixed eccentric control

Fig. 14—Geometry of oscillating gear segment and fixed eccentric control mechanism of Figs. 12 and 13



ENGINEERING DATA SHEET

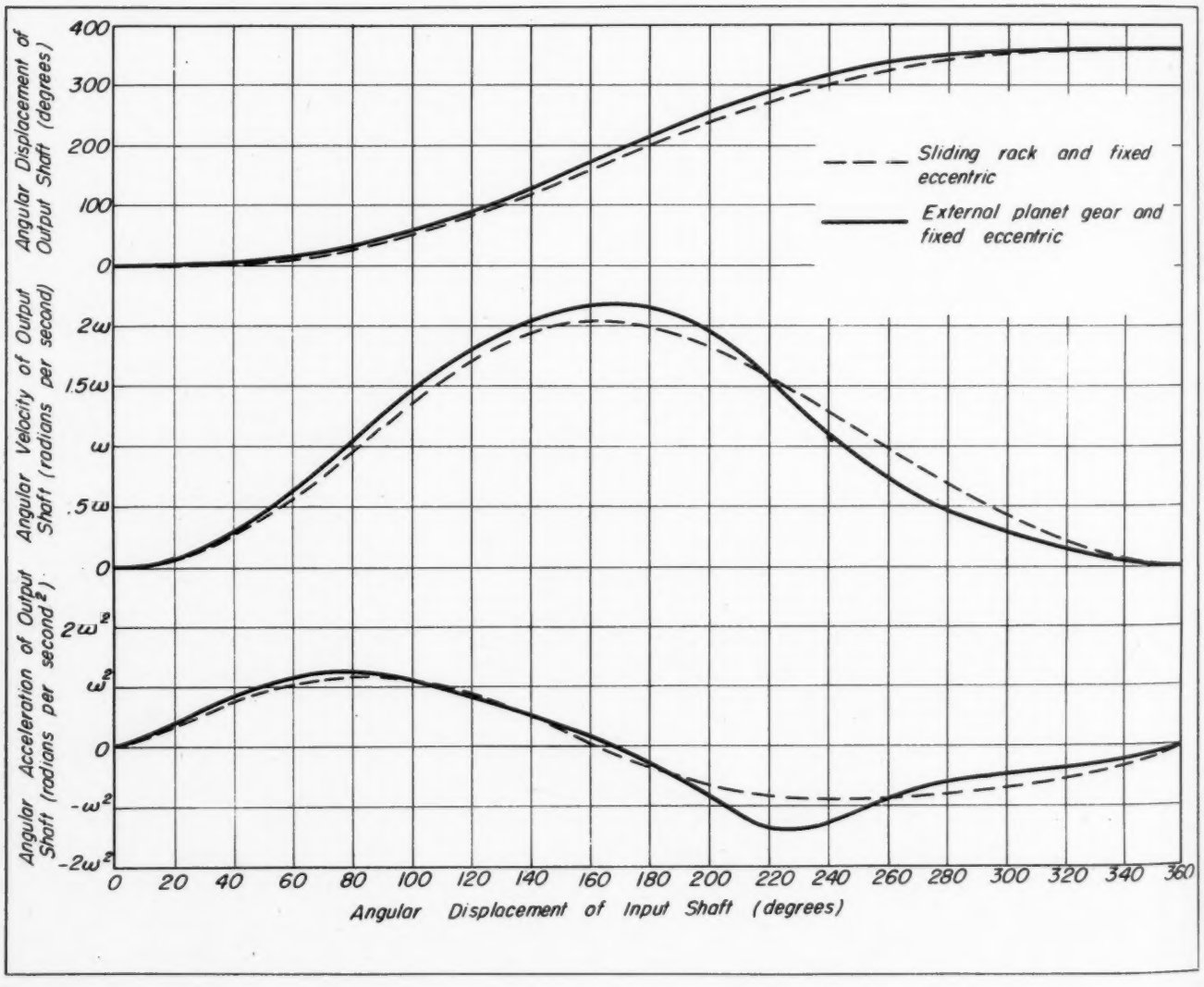
The conditions of zero acceleration at the start and zero deceleration at the end of the motion of the output pinion are obtained when: $\alpha = 45°$; $R_0 = R_{s1} \cos 45° = 0.7071\ R_{s1}$; $M = R_p \cos 45° = 0.7071\ R_p$; and $L = M + R_0 = 0.7071\ (R_{s1} + R_p) = 0.7071\ R_A$.

To compare the motion of the output pinion with that of the preceding device, the angular displacement, velocity, and acceleration have been plotted on *Fig.* 15 for values $R_{s1} = 1$ inch and $R_p = 3$ inches. Here, again, the curves are not symmetrical and deviate more from the curves shown in *Fig.* 7 than those obtained by the sliding rack and fixed eccentric mechanism. In many applications, this deviation is more than offset by the elimination of the sliding action present with the rack and fixed eccentric controlled mechanism.

While this device uses an external gear segment, the same results can be obtained with an internal gear segment.

Use of cam control mechanisms will be discussed in the third, and concluding, part of this series. Cams permit the incorporation of a period of dwell in the output motion.

Fig. 15—Motions of output sun pinions compared for fixed eccentric control mechanisms. Dotted lines show motion with sliding rack, Figs. 9 and 10, and solid lines the motion with oscillating gear segment, Figs. 12 and 13



new parts and materials

For additional information on these new developments see Page 379

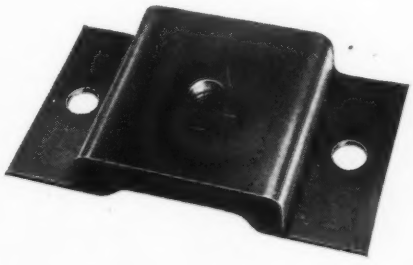
Miniature Radial-Thrust Bearings

Radial-thrust ball bearings are now made in the 5/64-inch size. They are of nonseparable design having machined bronze retainer carried by the inner ring. Dimensions are 5/64-inch bore, ¼-inch outside diameter and 3/32-inch width. ABEC tolerances are 1 and 5. Suitable for either high or low speed application the bearings are recommended for use in opposed pairs with preloading. Manufacturer: New Hampshire Micro Ball Bearings Inc., Peterborough 1, N. H.

For additional information circle MD 1 on page 379

High-Frequency Vibration Mount

Rubber vibration mount is designed to control shock, isolate high-frequency vibration and reduce noise transmission. Unit, known as the Shockmount,



is of the heavy-duty type with load capacity up to 7500 lb. It consists of an oil-resistant rubber block bonded between two 3/16-inch steel plates. Contour of the top plate limits motion and sheds dirt and oil. Overall height of the mount is 1 3/16 inches. Manufacturer: Lord Mfg. Co., Erie, Pa.

For additional information circle MD 2 on page 379

Automatic V-Belt Clutch

Dual dry clutch for V-belt drive is 6 inches in diameter and rated 3 hp. The unit is actually a dual clutch built into a compact unit. For driving it has a single-plate dry clutch; for use in cranking gasoline engines it has an integral overrunning clutch. Manufacturer: Salsbury Corp., 1161 E. Florence Ave., Los Angeles.

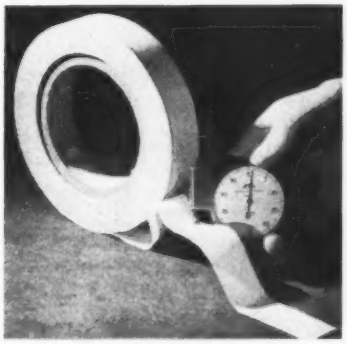
For additional information circle MD 3 on page 379

Oil Sight Gage

Type SFX sight gage permits observation of fluid flow, yet does not permit the liquid to touch, and therefore smudge, the view port. Unit has a cylindrical plastic sight cylinder supported between aluminum plates; glass cylinders can be supplied where required because of high temperature or other considerations. Sizes available include 1½, 2 and 2½-inch diameters with ⅛, ¼, ⅜, ½, ¾ or 1-inch pipe threads. Manufacturer: Oil Rite Corp., 3476 S. 13th St., Milwaukee 7.

For additional information circle MD 4 on page 379

Inorganic Electric Insulation

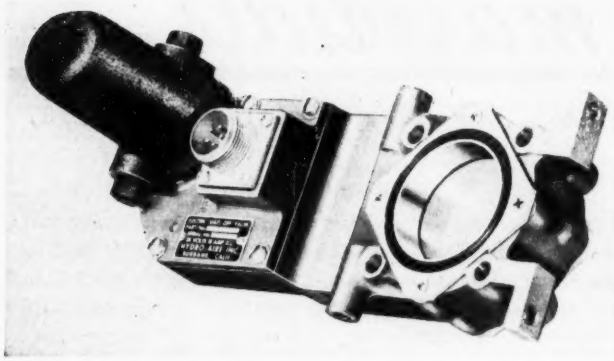


Asbestos-base paperlike electrical insulation material is made in thicknesses from 0.0015 to 0.020-inch. It is furnished in roll or tape form. Known as Quinterra, the insulation is of closed structure and has a paperlike rather than a fabric type composition. Noninflamable, it can be brought to a red heat under direct flame without igniting. At room temperature the minimum dielectric strength of the material is 250 vpm; at 800 C the dielectric strength is approximately 100 vpm. Manufacturer: Johns-Manville, 22 E. 40th St., New York 16.

For additional information circle MD 5 on page 379

Motor-Operated Gate Valve

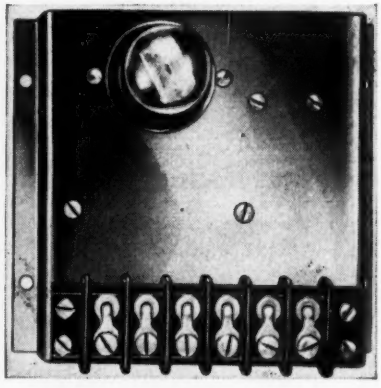
Unaffected by dust, humidity or water, motorized gate valve is operable at temperatures up to 550 F and is suitable for such applications as regulation of high-pressure engine fuel systems. Motor is a split-field series type operating on 18 to 30 volts. Limit switches and receptacle are integral with the unit. Operating time can be set to suit specifications, two-way thermal relief valves may be incorporated and



manual override can be provided. Feature of the unit is the seal design; seals may be removed without disassembling the entire valve. Manufacturer: Hydro-Aire Inc., Burbank, Calif.

For additional information circle MD 6 on page 379

Electronic Liquid-Level Controls



Liquid-level control, known as the Faratron, operates in any conductive liquid in any container. The control is electronic and has power input of 15 micro amperes. Two standard types of the model FE control are offered: The first for one level operation, either high or low; the second for two-level operation, both high and low. Dimensions are 4½ x 4¾ x 3½ inches. Unit is caseless and all parts are mounted on back of a plate. Manufacturer: Lumenite Electronic Co., 407 S. Dearborn St., Chicago 5.

For additional information circle MD 7 on page 379

Nylon-Base Rubber Diaphragms

Diaphragm sheet made of Nylon fabric impregnated with rubber has great flexibility as well as light weight, improved sensitivity and high bursting strength. It is available in sheets 36 inches wide and 1/32, 1/16, ⅛, 3/16 and ¼-inch thick. Manufacturer: United States Rubber Co., Rockefeller Center, New York.

For additional information circle MD 8 on page 379

Flow-Control Unit

Handling extremely small fluid flows with pressure drops of thousands of pounds, the Microflo control valve has Stellite seat and valve plug. Lapped fit and use of plug slots parallel to valve travel permit precise control with flow coefficients in the range 0.63 to 0.001. Both equal percentage and linear characteristics can be obtained. Manufacturer: Hammel-Dahl Co., 243 Richmond St., Providence 3, R. I.

For additional information circle MD 9 on page 379

Capacitor Type Fan Motor

Designed for use on direct-connected fans and blowers, the type C split-capacitor motor has no centrifugal switch. It is enclosed in a steel housing and equipped with lifetime-lubricated bearings. Available ratings are 1/20 to ¾-hp and either single or

two-speed control is optional; mountings include welded foot, through bolt, bolt-on base, or frame drilled to suit special requirements. Manufacturer: Electro Machines Inc., Cedarburg, Wis.

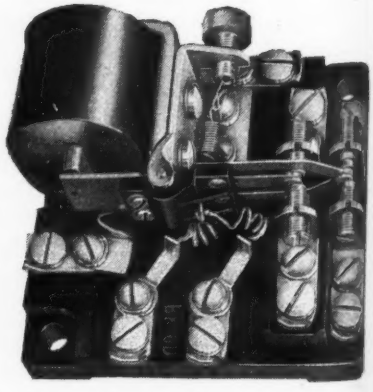
For additional information circle MD 10 on page 379

Striped Thermoplastic Tubing

Integrally-extruded contrasting-color striping is the feature of a new plastic tubing. Wear resistant, the striping serves as a color-code permitting permanent identification. Manufacturer: William Brand & Co., 276 Fourth Ave., New York 10.

For additional information circle MD 11 on page 379

Sensitive Relay



Designed for high sensitivity, the type BK relay is especially recommended for use under conditions of limited power supply and where precise operating characteristics are important. It is supplied in one or two-pole normally-open or normally-closed contact arrangements, single or double throw. The d-c coil rating is 32 volts at 24 milliwatts; a-c rating is 220 volts at 0.24 volt-am-

peres. Contact rating is 1 ampere at 48 volts d-c or 5 amperes at 110 volts a-c, noninductive. Dimensions are 2⅝ inches in length and width and 1 21/32 inches high. Manufacturer: Allied Control Co. Inc., Dept. S, 2 East End Ave., New York 23.

For additional information circle MD 12 on page 379

Lubricator Valve

Grannan lubricator will deliver a positive metered amount of oil or grease to each bearing in a lubricating system. The valve dispenses lubricants ranging in viscosity from light oil to heavy grease without valve adjustment. Unit is installed direct into the bearing assembly and does not require special grease guns to introduce lubricant. Operating temperature is from zero to 300 F. Manufacturer: Titeflex Inc., 532 Frelinghuysen Ave., Newark 5.

For additional information circle MD 13 on page 379

Air-Line Gas Adsorber

Designed to remove gases and vapors from air lines, the type PL gas adsorber will eliminate odors and other impurities not readily removed by filters. Unit functions by means of activated carbon and has no moving parts. Three sizes are available providing capacities from 45 to 285 cfm; all are rated 125 psi and 100 F. Manufacturer: W. B. Connor Engineering Corp., 114 E. 32nd St.,New York 16.

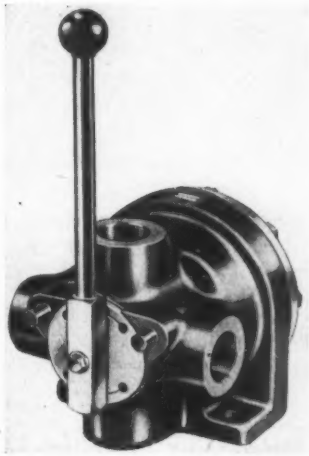
For additional information circle MD 14 on page 379

Magnetic Motor Starters

Line of magnetic motor starters and contactors is available in NEMA sizes 0, 1 and 1½. The units are supplied with NEMA type 1 general-purpose enclosures but are also available without enclosure for control panel application. Size 0 and 1 starters and contactors are built in 2, 3 and 4-pole construction with normally-open interlocks. For single-phase motors of higher ratings, the size 1 four-pole starter is reconnected with two pairs of poles in parallel to form a 2-pole starter. In this form it is designated size 1½. Features of the line include an overload relay which is adjustable for either manual or automatic reset. Manufacturer: Penn Electric Switch Co., Goshen, Ind.

For additional information circle MD 15 on page 379

Four-Way Selector Valves

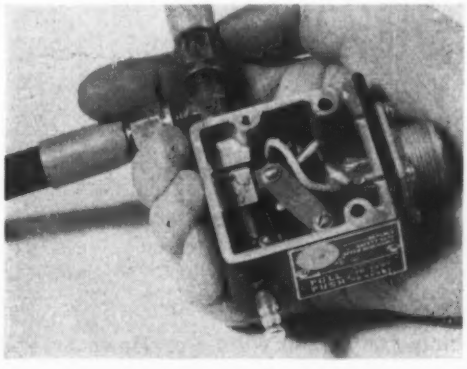


Features of the No. 8298 1½-inch, four-way selector valve are ease of operation and use of balanced detents for all three operating positions. A force of 35 pounds on the 12-inch handle actuates the valve at 5000 psi. Corrosion resistant, the unit has a forged steel body and is recommended for service with water, gas, or oil. Because of wiping seating action, dirt in fluid does not have a serious effect on the unit. Only one moving part is used in the design and no packing or lubrication is required throughout the valve life, which is estimated at over one million cycles. Manufacturer: Saval Co., 1915 E. 51st St., Los Angeles, 11.

For additional information circle MD 16 on page 379

Pressure-Actuated Latching Switch

Latching switch for electrical and mechanical indication of pressure discharges or excessive pressure gives visual warning of unusual conditions in a fluid

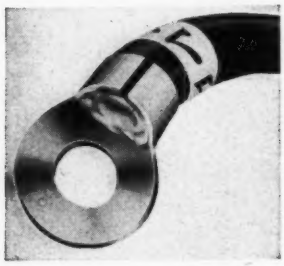


system. Switch measures 2½ x 3 inches and has three electric leads, one for normally-closed side of switch, one for normally open, and a power supply. Pressure, when applied to piston inside switch, dis-

places reset knob providing mechanical indication of the pressure condition. At the same time the switch is actuated and a small, replaceable, frangible disk on the side of the unit is blown out. Manufacturer: Consolidated Vultee Aircraft Corp., San Diego, Calif.

For additional information circle MD 17 on page 379

Wire and Cable Markers



Self-adhesive identification labels known as E-Z code wire markers can be attached to wires, cables and terminals to provide permanent identification and to facilitate correct wiring. So marked, the circuits can be identified quickly and easily. The markers are supplied in numbers 1 to 99, in letters of the alphabet and in the ASA and NEMA codes. They may also be printed to specification. Manufacturer: Western Lithograph Co., 600 E. 2nd St., Los Angeles 54.

For additional information circle MD 18 on page 379

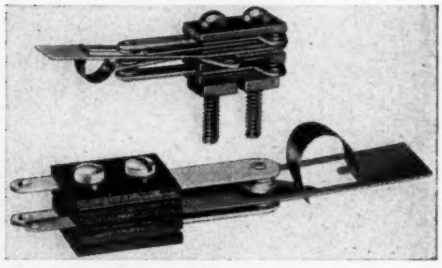
Nonlocking Clutches

Maxitorq floating disk clutch may now be obtained with nonlocking type levers so designed that the clutch cannot be locked into engagement. This type of clutch is particularly suitable for use with manually operated controls or where engagement of the clutch is rapid and frequent. Manufacturer: Carlyle Johnson Machine Co., Manchester, Conn.

For additional information circle MD 19 on page 379

Open-Blade Snap-Action Switch

Two models of the Acro open blade snap action switch are now available. Both have an Underwriter's Laboratory rating of 15 amperes at 125 volts

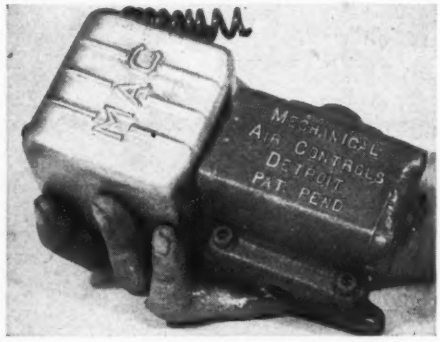


or 7½ amperes at 250 volts a-c. However, the larger switch is of more sturdy construction and has large contacts to assure longer life where the continuous-duty load closely approximates the rated load. Both units use the rolling-spring snap principle and both can be made with many variations in operating characteristics as well as form and length of blade. Manufacturer: Acro Electric Co., 1311 Superior Ave. Cleveland 14.

For additional information circle MD 20 on page 379

4-Way Solenoid Valve

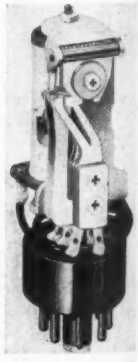
Solenoid 4-way air valve is recommended for the control of double-acting cylinders. The design incorporates the operating characteristics of the bal-



anced type valve and the pressure-seal feature of the poppet valve. Single moving part of the unit consists of a piston having two small O-rings, which engage hard chrome seats. Gland packing is thus obviated. Now made in the ⅜-inch size for any voltage or cycle requirements the valve requires only 2.4 amperes at 220 volts. Manufacturer: Mechanical Air Controls Inc., 3049 E. Grand Blvd., Detroit 2.

For additional information circle MD 21 on page 379

Light-Weight D-C Relay



Newly available type J d-c relay is especially suitable for installations where quick removal and easy replacement are desirable. It is supplied with standard octal base plug, the overall length of relay and plug being 3⅝ inches. Length of relay when installed is 2 15/16 inches, measured from the panel. Important features of the relay include high current-carrying capacity, high operating speed and efficient magnetic structure. Manufacturer: C. P. Clare & Co., 4719 W. Sunnyside Ave., Chicago 30.

For additional information circle MD 22 on page 379

Cellular Glass Pipe Insulation

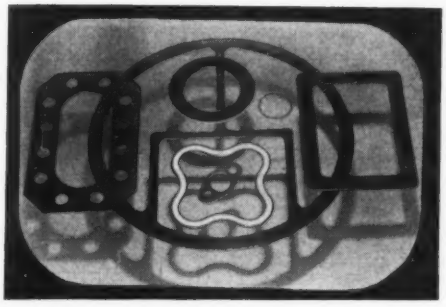
Cellular glass insulation is suitable for use on equipment for either indoor or outdoor operation. It may be used for insulating either hot or cold lines. The material retains its original insulating efficiency permanently, is unaffected by humidity and is resistant to chemical vapors. Standard sections are

half round and 18 inches in length. Manufacturer: Pittsburgh Corning Corp., 632 Duquene Way, Pittsburgh, Pa.

For additional information circle MD 23 on page 379

Heavy-Duty Metallic Gaskets

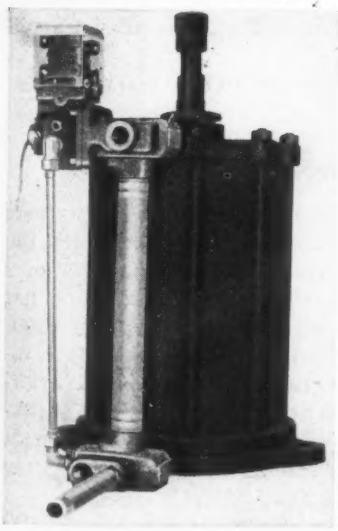
Fabricated of light-gage metal with asbestos filling, line of gaskets will withstand pressure and temperature extremes. Rated to 850 F and 1500 psi, they are suitable for use in chemical equipment and plastic extrusion and die casting machines. Gaskets can be



made in any shape and size and fabricated to suit specifications. Location of bolt holes is held within 0.015-inch. Manufacturer: U. S. Gasket & Shim Co., Cuyahoga Falls 24, Ohio.

For additional information circle MD 24 on page 379

Cylinder Control Valves



Control units for installation on pneumatic cylinders are said to increase greatly the work that can be performed per cubic foot of air. Units are 3-way valves that screw directly onto the pipe connections feeding the cylinders. Control can be at cylinder or at remote location connected to cylinder by tubing, however, speed can also be controlled by manual throttling at the individual exhausts. Sizes available include ½, ¾ and 1 inch. Manufacturer: Numatics, Milford, Mich.

For additional information circle MD 25 on page 379

Temperature-Sensitive Resistors

Electrical resistors available in the shape of rods, disks and beads respond to temperature variations as small as one thousandth of a degree centigrade. Known as Thermistors, they are made from mixtures of semiconducting metallic oxides and possess a high negative temperature coefficient. They are recommended for use as precision elements in engines, appliances and other equipment. Manufacturer: General Electrical Co., Pittsfield, Mass.

For additional information circle MD 26 on page 379

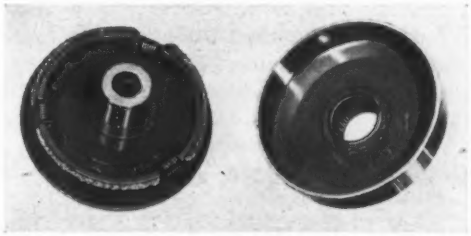
Cold-Setting Adhesive

Vinyl-base cold-setting plastic cement is suitable for adhering metals, plastics, ceramics and organic materials to themselves or each other. The material, known as Res-N-Glue, is moderately rapid drying, has a good wet grab and requires only one-surface application. Manufacturer: Schwartz Chemical Co. Inc., 326 W. 70th St. New York 23.

For additional information circle MD 27 on page 379

Centrifugal Clutch

Centrifugal clutch which utilizes an expanding shoe is recommended for units up to 3½ hp. It is particularly suitable for applications requiring high starting torques and low operating torques. Unit allows use of electric motors of low rating, since it delivers full peak torque. Made in two and three shoe sizes with 4¼ and 5¼-inch drum casings respectively, clutch may be operated at speeds from



750 to 2200 rpm. It functions equally well in clockwise or counter-clockwise operation. Manufacturer: Saginaw Products Corp., Saginaw, Mich.

For additional information circle MD 28 on page 379

Electronic Interval Timers

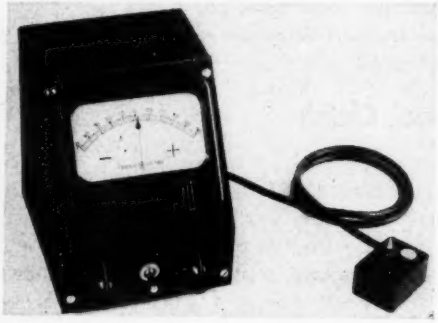
Designed for machine and process control, the series 30 electronic timers have a time range of 0.03-second to 4 minutes. Operating on 115 or 230-volt, 60-cycle current, the timers actuate two single-pole, double-throw switches having contact ratings of 10 amperes. Timing accuracy is within 2 per cent. The unit may be wired to provide interval timing, delayed action,

automatic repeat and programming as well as many variations of these. Recommended applications include controls for presses, feeders, welders, conveyors and machine tools. Manufacturer: Photoswitch Inc., 77 Broadway, Cambridge 42, Mass.

For additional information circle MD 29 on page 379

Remote-Reading Electric Micrometer

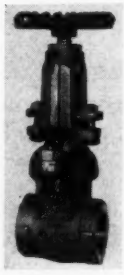
Micrometer suitable for remote reading will accept motions of +0.010-inch from the center position or 0.020-inch total in one direction. The micrometer head is a sturdy sealed unit equipped with a standard hardened-steel tip. An adjusting screw is provided so that contact pressure may be varied over the range 3½ to 10 ounces. Precision of the assembly



is 0.00025-inch. The control unit is dial reading with a zero-center scale; two knobs are provided for adjusting voltage and zero. Operation is from 2-volt storage battery. Manufacturer: Stevens-Arnold Inc., 22 Elkins St., South Boston 27, Mass.

For additional information circle MD 30 on page 379

Corrosion-Resistant Gate Valve

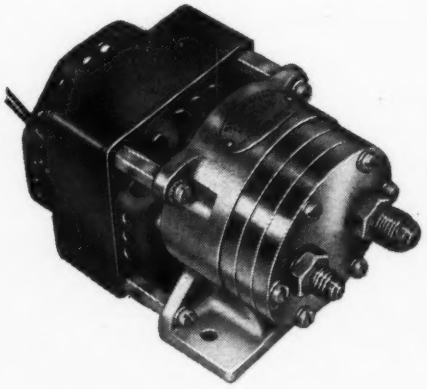


Stainless-steel gate valve for the chemical, processing and food industries is so made that all parts contacting process fluid are of corrosion-resisting alloy AISI type 316. The valve is of the outside screw and yoke type having bolted bonnet, tapered wedge and screwed ends. Sizes available include ½ to 2 inch. Packing and gaskets are corrosion resisting and yoke bushings are renewable. Manufacturer: Ohio Injector Co., Wadsworth, Ohio.

For additional information circle MD 31 on page 379

Metering Pump

Corrosion-proof metering pump for use with vending and other machines has a capacity of 10 cc per second. Feature of the pump is accuracy despite wide temperature change or viscosity variation. The meter is of stainless steel and carbon construction and will not contaminate most liquids or be affected by them. Incorporated is a check valve that insures instantaneous discharge and prevents dripping and leakage when the pump is not operating. Unit is powered by a 1/35-hp shaded-pole induction motor



operating on 115-volt 60-cycle current. It will fit within a space 4 inches square and 6½ inches long. Manufacturer: Mechanical Products Corp., 168 N. Ogden Ave., Chicago 7.

For additional information circle MD 32 on page 379

High-Tensile Rubbers

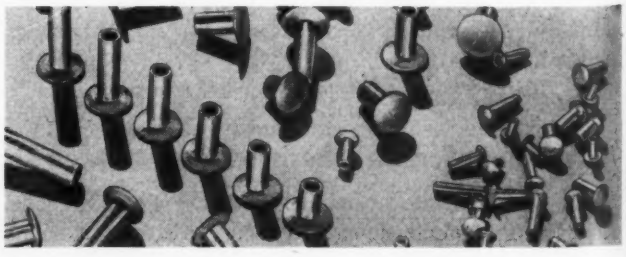
New synthetic rubber material has 1800 psi tensile strength and over 400 per cent elongation. The material, known as Fel-Pro 131, is made in Durometer A hardnesses ranging from plus 80 to minus 5 and can be cut, molded or extruded to suit requirements. Manufacturer: Felt Products Mfg. Co., 1504 Carroll Ave., Chicago 7.

For additional information circle MD 33 on page 379

Zinc-Alloy Tubular Rivets

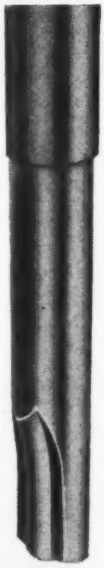
Made of corrosion resistant zinc alloy, GRC rivets are suitable for all applications not requiring the strength of brass or steel. They are made in oval head sizes from 1/16 to 9/64-inch diameter and flat countersunk heads in 9/64-inch diameter. Semitubular rivets are made in sizes from 1/16 to ⅛-inch diameter in lengths up to ⅝-inch. Rivets are also available with specially shaped heads of geometric or ornamental design, or large diameter heads that cannot be made by heading. Manufacturer: Gries Reproducer Corp., 780 E. 133 St., New York 54.

For additional information circle MD 34 on page 379



Mr. President: Increased production is the key to lower costs. When presidents of a wide variety of other concerns say they have scored assembly production increases ranging from 15% to 50% . . . and when they credit these increases to change-over to CLUTCH HEAD . . . this modern screw should merit your investigation.

TYPE "A" ASSEMBLY BIT



COMMON SCREWDRIVER

Mr. Engineer: Your selection of fasteners is important to the speed, safety and smooth operation of assembly . . . also to simplified field service, so vital to the "job performance" of your product. CLUTCH HEAD invites you to make a comparison on these points *with all other screws* on the market . . . recessed heads as well as slotted.

Mr. Purchasing Agent: Your experience tells you that the cost of screw APPLICATION is the factor that determines lower or higher FINAL COST in assembly. Users attest that CLUTCH HEAD'S exclusive features reduce costs with a 3-way step-up in production . . . faster, safer and easier driving; plus near-zero in tool maintenance cost.

Mr. Superintendent: Your main concern, and that of your foremen, is a smooth, safe, and steady tempo on the line. The high visibility of CLUTCH HEAD's recess is a speed factor, even with "green" operators; dead-center entry checks out driver canting and chewed-up heads; the non-tapered driving engagement (free from "ride-out") eliminates risk of skid damage and disposes of operator fatigue from fighting end pressure.

Gentlemen: These and *other exclusive advantages of CLUTCH HEAD will be apparent to you on examination. May we mail you screw assortment, sample Type "A" Bit, and illustrated Brochure? Check all the above features! also the ruggedness of the Type "A" Bit for longer continuous service and simple 60-second reconditioning; the value of the Lock-On for one-handed reaching; and CLUTCH HEAD'S basic recess design for common screwdriver operation.*

CLUTCH HEAD · SCREWS ·

UNITED SCREW AND BOLT CORPORATION

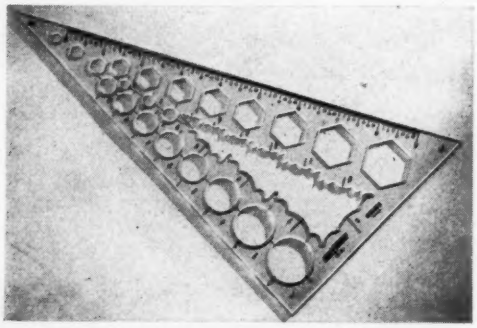
CLEVELAND 2 CHICAGO 8 NEW YORK 7

engineering dept equipment

In order to obtain additional information on this new equipment see Page 379

Drafting Template

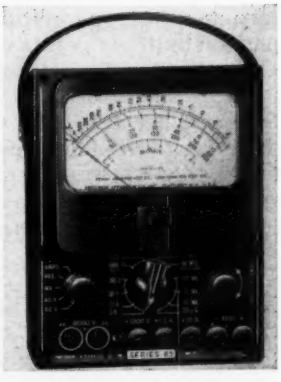
Plastic drafting template known as the No. 201 Detailer contains top and side profiles of all of the most commonly used hexagon bolts, nuts and screws in addition to circles from 3/16 to 1 inch in diameter. Made



of laminated clear plastic with the printing beween the laminations, the template is in the form of a 10-inch 30-60 triangle. Manufacturer: Rapidesign Inc., P. O. Box 592, Glendale, Calif.

For additional information circle MD 35 on page 379

High-Sensitivity Electric Test Set



High sensitivity test set known as series 85 incorporates a wide-angle 50 microampere meter with 2-color scale plate and large easy reading numerals. It has a sensitivity of 20,000 ohms per volt dc and 1000 ohms per volt ac. Its thirty - four self - contained ranges will measure up to 6000 volts, 120 microamperes, 70 db and 60 megohms. Case is Bakelite and measures 5½ x 7⅛ x 3 inches. Manufacturer: Precision Apparatus Co. Inc., 92-97 Horace Blvd., Elmhurst, N. Y.

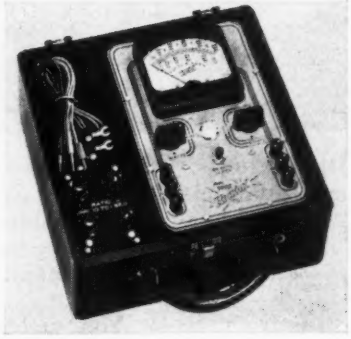
For additional information circle MD 36 on page 379

Printing and Developing Machine

High-speed ammonia type printing and developing machine accommodates continous roll paper as well as cut sheets. It has a maximum speed of 25 ft per min. Features of the unit include front or rear delivery with front stacking of prints up to 12 by 18 inches; automatic separation of print from original; thermostatic heat control and electronic speed control. Light is supplied by a new type high-pressure mercury-vapor lamp. Material is accommodated in widths up to 42 inches at speeds as low as a few inches per minute. Operation is on 60-cycle, 215-volt power. Dimensions are 78 inches long, 38 inches deep and 79 inches high. Manufacturer: Ozalid Div., General Aniline & Film Corp., Johnson City, N. Y.

For additional information circle MD 37 on page 379

Volt-Ampere Wattmeter



Model 900B test meter will indicate wattage, amperage and line voltage; it is recommended for use in testing appliances and other low-power consumption equipment. Unit is mounted in a portable carrying case and has a 3¾-inch meter scale. The a-c ranges included are: 0-10,000 watts; 0-130 amperes; 0-260 volts; and 0-260 milliamperes. Manufacturer: Hickok Electrical Instrument Co., 10545 DuPont Ave., Cleveland 8.

For additional information circle MD 38 on page 379

Fraction-Adding Chart

Chart for the rapid adding of fractions facilitates the addition of any two fractions from 1/64 to 63/64-inch in 1/64-inch steps. Fractions are added by selecting one on each of the two edges of the chart and noting point of intersection of ruled lines; diagonal line intersecting this point will have numerical value equal to the sum of the two. Subtraction can also be done by reversing the procedure. Manufacturer: H. M. Edmunds Co., 6 E. 39th St., New York 16.

For additional information circle MD 39 on page 379

What happens to your drawings?

Is one drawing enough, or do you need copies?

Place your drawing on any one of the many Ozalid sensitized materials, feed it into the Ozalid machine, and you will have a positive (not negative) copy, dry-developed and ready to use, in a matter of seconds!

Do you change or make additions to originals?

Instead of altering or changing your original, do it on a translucent Ozalid print. You can then combine as many changed prints as you wish by putting them on transparent Ozalid film, overlaying them on a sheet of Ozalid sensitized paper, and processing!

Do you want drawings on different weight papers?

Ozalid papers are available in light, standard, and heavy weights. You can even make Ozaprints with reproductions on both sides of the sheet!

Do you want color coded drawings?

Reproduce your drawings on Ozalid papers in black, blue, red or sepia on white or tinted backgrounds. Color code prints for different departments . . . color code different circuits, dissimilar lines or symbols, etc. for greater clarity.

Do you need extra masters?

Make translucent Ozalid Intermediates directly from your tracings for use as "masters" in your printmaking. This saves the original . . . provides "masters" for different departments, branches, contractors, etc. (Ozalid Intermediates are actually better to print from than original drawings. They increase line density; can be made on new Ozalid plastic surfaces which are impervious to staining and smudging.)

If you can make drawings—or use them—Ozalid can save you time and money. Write today, and learn more about *how* Ozalid can tighten up lost time and money in your field.

ALL OZALID PRINTS PRODUCED IN SAME MANNER

★ **No tie-ups when you shift from one type of print production to another. Simply choose your Ozalid material . . . and your Ozalid Streamliner exposes and dry develops it. Standard work prints are produced in 25 seconds.**

★ **Your drawings can be up to 42 inches wide, any length. Roll stock or cut sheets can be used. (Special machines accommodate 54" wide drawings.)**

★ **You—or anyone else—can be the operator. A few hours and you're an "expert."**

★ **See *all* the Ozalid prints you make from any drawing . . . and learn full story. Mail coupon today.**

DEPT. NO. 182

OZALID A Division of General Aniline & Film Corp., Johnson City, New York

Gentlemen: Please send free copy of Ozalid Streamliner booklet illustrating all types of Ozalid prints.

Name_____ Position_____

Company_____

Address_____

_____

Ozalid in Canada—Hughes Owens Co., Ltd., Montreal

MEN... of machines

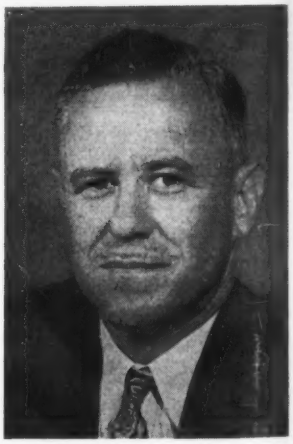
Marvin W. Smith

MARVIN W. SMITH has been elected executive vice president of the Baldwin Locomotive Works, Eddystone, Pa., in a new association which will bring about closer co-operation between the Baldwin and Westinghouse organizations. Previously Mr. Smith had been vice president in charge of engineering and research for Westinghouse Electric Corp., with whom he had been associated for thirty-three years. A native of Texas, Mr. Smith was graduated from Texas A. and M. in electrical engineering in 1915. As a student engineer at Westinghouse he was selected by the late Benjamin G. Lamme, chief engineer of the company, for a special course of study in design problems. He was appointed a division engineer in 1930 and was in charge of the design of generators for the Hoover and Norris dams. In 1936 he became manager of engineering and was elected Westinghouse's vice president in charge of engineering and research three years later. Mr. Smith is an authority on power plant design and development.

LEROY R. GRUMMAN, chairman of the board of the Grumman Aircraft Engineering Corp., Long Island, N. Y., has been awarded the 1948 Daniel Guggenheim medal "for outstanding achievement in successfully advancing aircraft design both for Naval and peacetime use." A partial list of former recipients of this, the highest American aeronautical honor, includes: Orville Wright, Glenn L. Martin, Donald Douglas, Lawrence D. Bell, and T. P. Wright. Mr. Grumman has been associated with the field of aeronautics since serving as a Navy pilot in World War I. After working his way through Cornell University, and during his service with the Navy, he attended Massachusetts Institute of Technology. With two associates, Mr. Grumman organized the company bearing his name in 1929. He is particularly well known for development of carrier-based aircraft and the design of folding wings for airplanes which increased greatly the capacity of aircraft carriers. Mr. Grumman is a fellow of the Institute of the Aeronautical Sciences and a member of the Society of Automotive Engineers, and participated in the organization of the Cornell Aeronautical Laboratory.

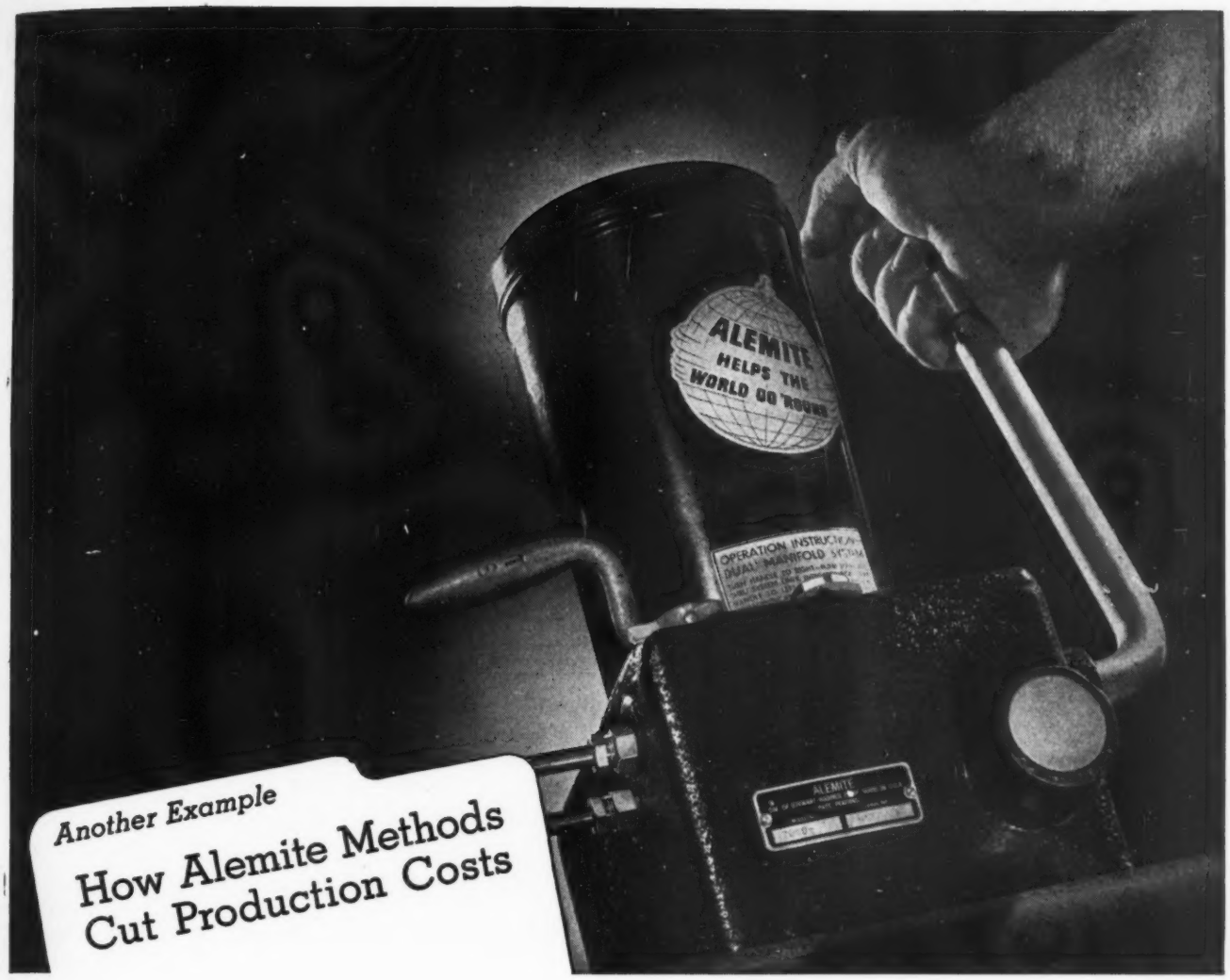
Leroy R. Grumman

ROBERT F. KOHR is now director of engineering research for the Ford Motor Co., Dearborn, Mich. A member of the Ford engineering staff for three years, Mr.



Robert F. Kohr

Kohr has served as acting director since Feb. 26, at which time he was chosen to fill the vacancy created by the resignation of William S. James. Mr. Kohr is a mechanical engineering graduate of the University of Michigan. He was employed as a mechanical engineer in the auto power plant section of the U. S. Bureau of Standards from 1920 to 1926, and has held other specialized po-



Another Example

How Alemite Methods Cut Production Costs

Reduces 182 Lubrication Points to One!

Adds Productive Time to Machines with Faster, More Efficient Handling and Application of Lubricants

Protect Those Machines You Design from Human Error

Human error in lubrication can easily destroy the efficiency of the best designed machine. A five minute conference with an Alemite Representative may well reveal modern features that make lubrication foolproof. This man is fully qualified to help you because he is a specialist in modern methods of handling and applying lubricants. Write to Alemite, 1804 Diversey Parkway, Chicago 14, Illinois.

Whether it's only one hard to reach bearing on a machine or 182 lubrication points on another, they can all be perfectly lubricated by this modern Alemite Method. With one hand, and a few strokes on a handle, any bearing, no matter how remote, is lubricated completely in seconds from one safe, central point while the machine keeps on producing!

An Alemite Centralized Lubrication System eliminates "human error," adds more productive time to any machine. It delivers a measured amount of lubricant to each bearing, then signals when the job is completed. Result—no costly bearing failures due to hit-or-miss, feast-or-famine lubrication.

Just one of many ways that Alemite Methods help industry cut production costs through simplified lubrication procedures. And the Alemite Representative can show case after case where a time study analysis has proved that his methods reduce maintenance costs. These methods eliminate costly, time-consuming handling of oils and greases... slash shutdown time for lubrication . . . completely mechanize lubrication from barrel-to-bearing . . . save grease . . . keep dirt and moisture out of lubricants. These benefits all add up to lower production costs and longer machinery life. Get the complete facts, today.

ALEMITE

Another Product of STEWART WARNER

MODERN LUBRICATION METHODS THAT CUT PRODUCTION COSTS

sitions with the Bureau of Aeronautics, Studebaker Corp., and Bendix Aviaiton Corp. Prior to joining Ford in 1945, he was chief liaison engineer, aircraft development section, for General Motors Corp.

♦

CHARLES DAVIES, industrial designer, New York, and formerly president of the Davies Air Filter Co., has been appointed design consultant for the U. S. Air Conditioning Corp., Minneapolis.

♦

WALDEMAR NAUJOKS recently joined the staff of Girard Associates, Chambersburg, Pa., forge and press shop engineers. For many years Mr. Naujoks was chief engineer at the Steel Improvement Forge Co., Cleveland, and more recently was manager of the forged valve division of Ohio Injector Corp., Wadsworth, O. Mr. Naujoks is an authority on forging practice and is a contributor to MACHINE DESIGN.

♦

DR. KARL COHEN has joined H. K. Ferguson Co., as technical director for atomic activities. Dr. Cohen was one of the contributors to the design of the K-25 plant at Oak Ridge, Tenn., and has served as specialist on industrial applications of atomic energy for Standard Oil Development Co.

♦

JOHN E. CALLOUETTE has been appointed chief engineer of the Osgood Co., Marion, O., succeeding FRED L. WHITE, who has been named development and consulting engineer. Mr. Callouette formerly was design engineer for Clark Bros. Corp., Olean, N. Y.

♦

L. S. COPE has been named head of research and product engineering at Oliver Iron & Steel Corp., Pittsburgh. In his new capacity Mr. Cope will assume technical direction of die and tool engineering, metallurgical and special mechanical engineering and product development.

♦

DR. FRANK D. CARVIN, head of the mechanical engineering department and chairman of the graduate division at Newark College of Engineering, Newark, N. J., recently was appointed head of the department of mechanical engineering at Illinois Institute of Technology, Chicago.

♦

WALTER G. WHEELER recently was appointed chief engineer, Hufford Machine Works Inc., Redondo Beach, Calif. An engineering graduate of California Institute of Technology and a member of the American Society of Mechanical Engineers, Mr. Wheeler has been associated with the Hufford company since December, 1947.

♦

E. H. BROWN has been elected vice president in charge of engineering development of Allis-Chalmers Mfg. Co., Milwaukee.

♦

WILLIAM P. LEAR recently was elected to the newly created post of chairman of the board of Lear Inc., Grand Rapids, Mich. He will also continue to serve as director of research and development. RICHARD M. MOCK, executive vice president since 1947, was elected president. Mr. Mock had also served as application and chief engineer of the company's electro mechanical division.

♦

ELWYN KAAKE, formerly on the engineering and production staff of Hydraulic Machinery Inc., has been appointed chief engineer in charge of engineering and production for Power Plus Products Co., Detroit.

♦

J. W. MCNAIRY has been named manager of engineering and manufacturing for the appliance and merchandise department of General Electric Co., Bridgeport, Conn.

♦

L. R. CLAUSEN has been elected chairman of the board of directors, J. I. Case Co., Racine, Wis. He will continue in charge of research, development and engineering but has resigned as president, a post he has held since 1924.

♦

S. J. LEVINE has been appointed manager of engineering for the air conditioning department of General Electric Co., Bloomfield, N. J.

♦

FRANK J. KENNEDY, manager of the engineering department of the Ambridge, Pa., plant of National Electric Products Corp., Pittsburgh, has been elected a vice president of the corporation.

♦

KEITH E. COXE, formerly a tool technician for Glenn L. Martin Co., Baltimore, recently joined the S. Morgan Smith Co., York, Pa., as design engineer.

♦

JOSEPH RICHTER has become assistant project engineer, Wright Aeronautical Corp., Wood-Ridge, N. J. He formerly had been a mechanical engineer at the Navy Engineering Experiment Station, Annapolis, Md.

♦

HARLOW H. CURTICE, formerly general manager of the Buick Motor Div., has been elected an executive vice president of General Motors Corp. Since he will be in charge of general staff activities, included under his general direction are styling, engineering and research activities.

♦

PROF. GREGORY J. COMSTOCK has been retained by Lake Erie Engineering Corp., Buffalo, as consultant in the field of powder metallurgy and its equipment. In addition, Professor Comstock will carry on extended research and development work in powder metallurgy as applied to hydraulic press design and application.

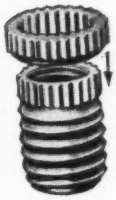
♦

E. W. CHAPMAN recently was appointed vice president in charge of engineering, Tuthill Pump Co., Chicago. Mr. Chapman, a mechanical engineering graduate of Purdue University, at one time was development engineer and later was chief engineer of the Blackmer Pump Co. Prior to his present appointment he was vice president in charge of engineering for the industry pump division of Bowser Inc.

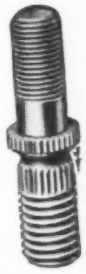
SPECIALTY FASTENERS

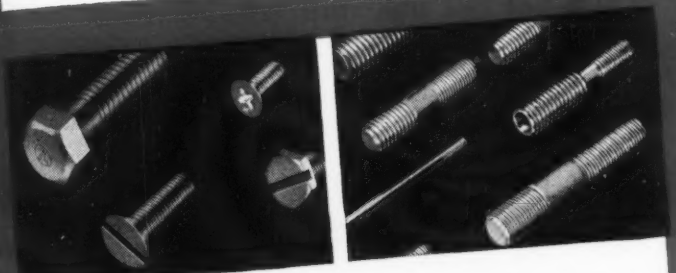
to fit unusual fastening jobs

If your fastening job requires a difficult or unusual method of fastening, it is very likely that "National Screw" has a specialty fastener to fit your requirements. Here are three of the many "National" Specialties that have proved successful.

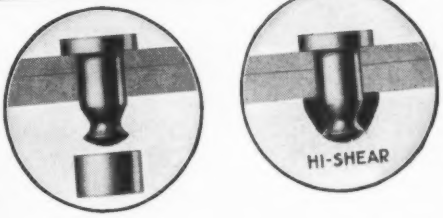


"ROSÁN"* INSERTS *give the strength of a steel tapped hole to soft metals, plastics or wood.* A serrated ring locks the insert to the parent material so that it can't loosen, turn or pull out under tension or torque. *ROSÁN STUDS* can't loosen or turn—even under vibration.





"LOK-THRED"** *fasteners hold securely in place.* This new thread design for studs, bolts and screws is the only thread that of itself holds tight. Actually, it becomes *tighter* in service, even under vibration. Stronger in both tension and torsion, "LOK-THRED" forms a seal that liquids under pressure cannot penetrate.



"HI-SHEAR"* RIVETS *reduce weight, increase shear strength.* "Hi-Shear" Rivets have a shear strength of 75,000 p.s.i. When used to replace bolts and nuts, they reduce weight and are easier to install. The "Hi-Shear" Rivet consists of a specially formed heat-treated alloy steel pin, headed at one end and grooved at the other. An aluminum collar fits the grooved end and forms a high button head when deformed by a riveting tool. To remove, simply destroy the collar and push out the rivet.

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PRODUCTS

Write for descriptive booklet on any of these specialty fasteners. Please specify which ones interest you.

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(**Pat. Applied For.)

THE NATIONAL SCREW & MFG. COMPANY, CLEVELAND 4, OHIO

Steels

(*Continued from Page* 92)

of heat treatments might not be sufficiently great to bring out the full advantages of the alloy steel. In such cases, it is often possible to reduce the size of the shaft required (say to 6-inch diameter) by making use of a steel in this group and depending upon satisfactory response to heat treatment. If torsional properties are of major importance, a 2 or 3-inch diameter hole could be bored through the center of the shaft with little if any detrimental effect. The well-known reason for this is that, in torsion, the outer fibers are mainly stressed while the center is relatively free from stress. Furthermore, if proper steps are taken in quenching and tempering the hollow bored shaft, both the bored and outer surfaces are exposed to the quenching medium which would result in raising the overall strength to a value comparable to that of a smaller section, perhaps 2 or 3-inch, instead of the original 6-inch section.

High-Carbon Water and Oil Hardening Steels

These steels are commonly in the 0.65 to 1.10 per cent carbon range and most are of the tradename variety. These steels are usually in a somewhat higher priced field than other types heretofore mentioned due to their high carbon and alloy contents and because of the greater care which must be taken in their manufacture in order to insure sound material. Application is generally for parts requiring high hardness (55 to 65 Rockwell C) together with high tensile and yield strength.

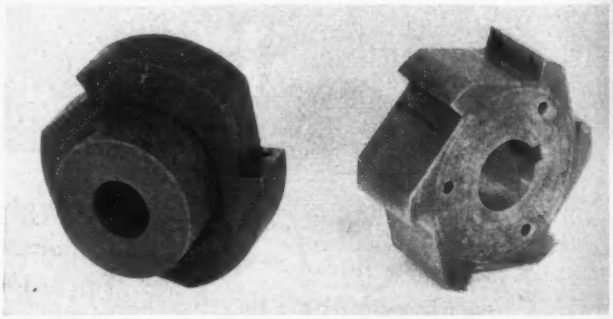
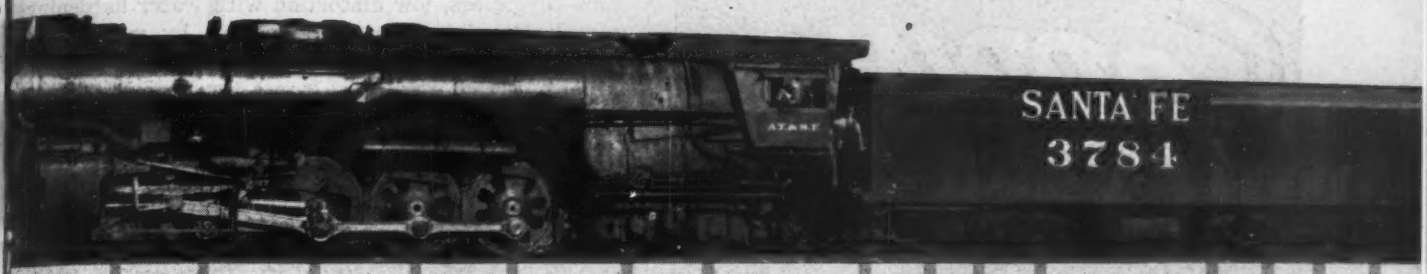
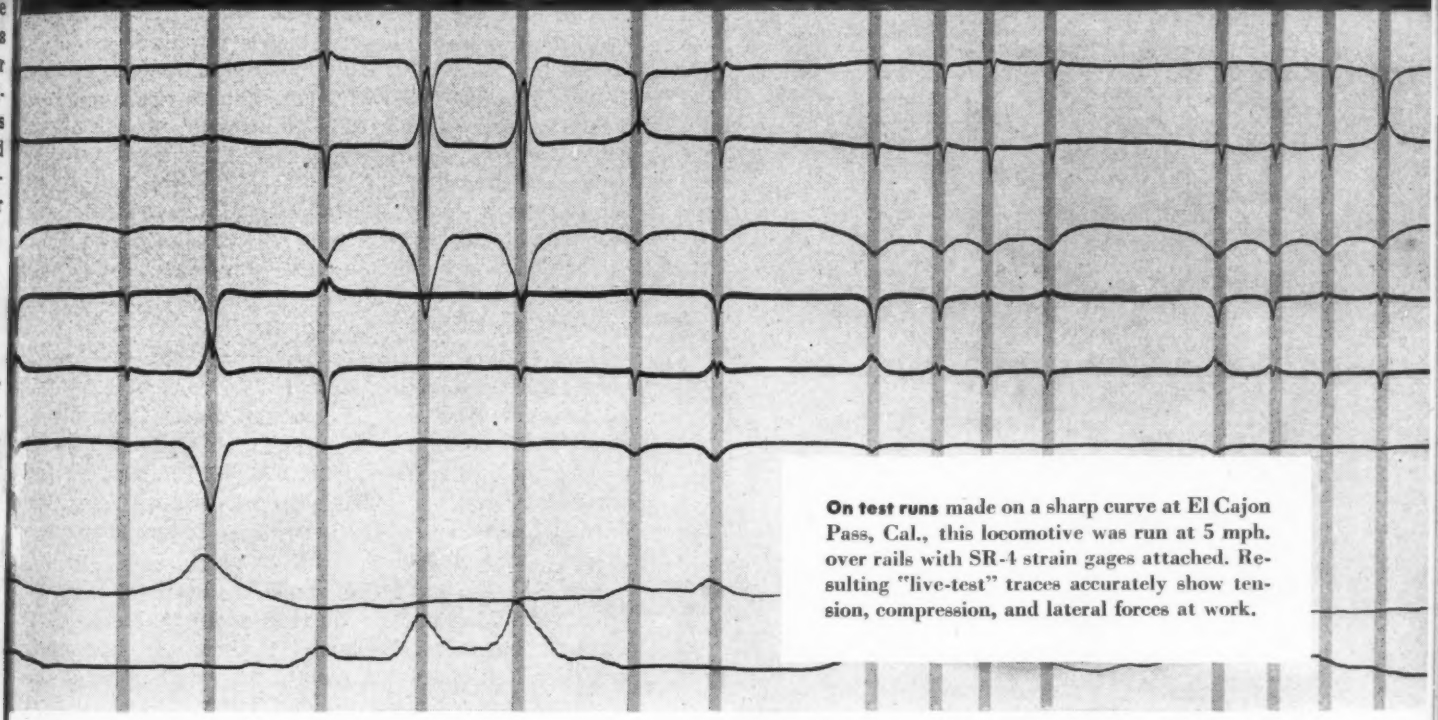


Fig. 6—Two special cams made from oil hardening steels to assure minimum distortion and adequate strength

WATER HARDENING (includes AISI C1065-95): These steels are for parts requiring over 60 Rockwell C hardness and not so intricate as to be subject to excessive distortion or cracking by the water quench. Many spring parts are made from steels in this group particularly those that harden more or less completely throughout. Some steels of this type are produced with a fine grain and are "shallow hardening". High case hardness to a depth of ⅜-inch can be developed, depending upon the quenching temperature. This case is backed up with a tough core of about 40 to 55 Rockwell C. *Fig.* 5 shows a variety of parts

How railroads help reduce wear and tear on trackage...with photo-trace recordings





On test runs made on a sharp curve at El Cajon Pass, Cal., this locomotive was run at 5 mph. over rails with SR-4 strain gages attached. Resulting "live-test" traces accurately show tension, compression, and lateral forces at work.

WHAT happens to track when a 247-ton locomotive takes a curve? How much pay load can be hauled at high speeds with least damage to tracks? What changes in design will reduce track wear...?

The Research Division of the Association of American Railroads is finding the answers to such questions from photo-traces.

Made under actual operating conditions, the above traces show the relation of equipment to track in terms of tension, compression, and lateral movement.

They were obtained by placing SR-4 strain gages on three points of a cross-section of the inner rail (top three traces), and outer rail (middle three traces). Tension and compression for the top six traces is 40,000 lb./sq. in. per inch deflection on the original scale. Bottom two traces represent lateral movement of the heads of the two rails on a scale of .33 in. per inch deflection on the original scale.

How photo-trace recording can help you . . . When fast-moving transients are important in any industrial operation, take advantage of the capacity for vital detail, permanently recorded, that photography adds to your test instruments. To help you in this work, Kodak provides a wide selection of films and papers for all photographic instrument recording requirements. For further information, send for the Kodak Linagraph folder and its helpful film and paper selection chart.

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made from this type of material; included are staple formers, a jeweler's lathe spindle assembly, a spring collet, and a drawing die. These parts required a hardness of 60-65 Rockwell C, resistance to wear, good toughness, low distortion with water hardening, and depth of hardness controllable by variation in hardening temperature. Other parts often made from steels in this group are cams, ratchets, ball races, centers, etc.

OIL HARDENING: For parts requiring a Rockwell C hardness of 55 to 62, minimum distortion is obtained with these steels. An ideal application for a steel in this group is for cams such as those illustrated in *Fig.* 6. Made from a 0.70-carbon-chromium-nickel-molybdenum steel, the physicals required are high hardness (61 Rockwell C), maximum toughness, low distortion, and great strength. There are numerous steels on the market in this group with varying qualifications—some are tougher than others, some develop better resistance to wear, etc.—and the safest course for the designer to follow is to check with different steel companies to determine which is best suited for the job in mind if results through actual experience are not available. Other uses are clutches, collets, ratchets, gears, bushings, etc.

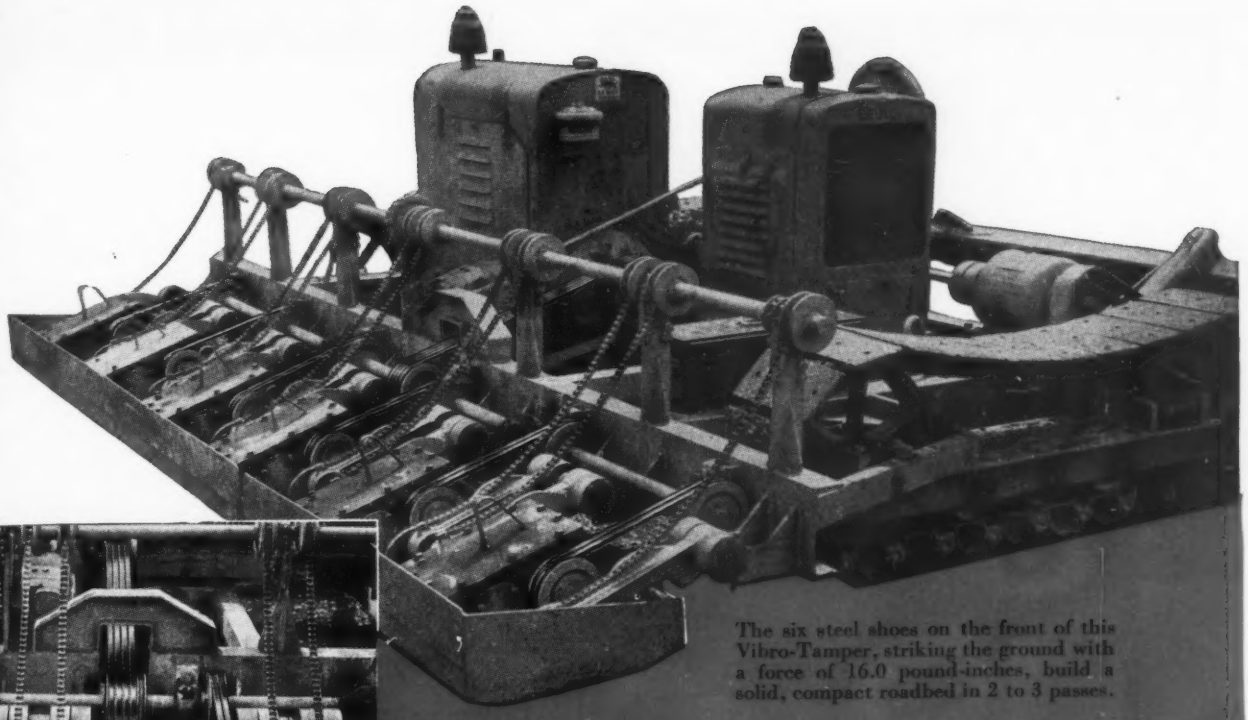
HIGH-CARBON, HIGH-CHROME: For parts requiring very high through hardness (62-64 Rockwell C) and high wear resistance. If extreme shock is involved, steels in this group may break in service and in such cases it is well to consider a steel in the tougher, oil hardening group. Hard chrome plating over the hardened steel as a base in order to insure resistance to wear can be resorted to if necessary.

AIR HARDENING: These steels are used for very intricate machine parts requiring about 60 Rockwell C through hardness. Because of their air hardening qualities less distortion results than with other steels requiring more drastic oil and water quenches.

Stainless Steels

As the name implies these steels are highly alloyed to resist stain and corrosion. They vary in carbon from 0.10 per cent up and the different types show great variations in machining qualities. Parts that have to resist corrosion and high temperature are the principal applications for these steels; they resist to a certain extent the corrosive action of salt water, sulphuric and other acid atmospheres. Common uses are for parts such as furnace skid rails, rollers and dampers, bolts, studs, tie rods, valve parts, pump shafts, bearing surfaces, ball bearings and races. In view of their high price and the greater cost of processing they are not generally used if one of the lower priced steels in the other groups is satisfactory.

With the hundreds of steels on the market it is true, as might be suspected, there is no clear line of demarcation between the different aforementioned groups. If there is a doubt as to what to use it is always better to consult a reputable metallurgist or steel supplier for pertinent information. The second and concluding part of this article, to appear in the next issue of MACHINE DESIGN, will cover the various methods of heat treatment, their salient points, and their influence on the selection of steels.



The six steel shoes on the front of this Vibro-Tamper, striking the ground with a force of 16.0 pound-inches, build a solid, compact roadbed in 2 to 3 passes.

How Dayton V-Belts transmit power and drive the cambers at the base of each shoe to create true vertical plane vibrations

HOW TO MAKE 285 LB. SHOES ...tap dance 1500 times a minute!

DAYTON V-Belts supply power, withstand terrific vibrations, ignore sand, gravel

Road building calls for foundations that are solid, compact and even. When coarse aggregate is used, fines must be solidly packed into the chinks and voids, and for the full depth of the base.

A new machine, called the Vibro-Tamper, has been developed to do this important work faster, better and at less cost. Employing six 285-lb. shoes, each 16 inches long and 24 inches wide, it literally shakes and hammers the fines down into the coarse aggregate . . . at vibrating speeds ranging from 2800 to 3000 rpm!

High speed, terrific vibration and abrasive conditions were the drive problems this manufacturer had to solve. He specified Dayton V-Belt Drives. First, for their ability to supply power efficiently at high speeds. Second, they have greater flex strength. Minimum stretch. And third, because Dayton V-Belts can take it, withstand abrasive conditions.

Industrial Designers!

All standard Dayton V-Belts have the extra strength of Raytex Fortified Cords . . . the specially processed Rayon cords that make possible minimum stretch, maximum strength and longer life. For the complete story, write today for Booklet A-469.

This is another example of how designers depend on Dayton V-Belts for power transmission under unusual conditions. No matter what your drive problem, a Dayton Power Transmission Specialist stands ready to help you. Call your local Dayton office or write: *The Dayton Rubber Company, Dayton 1, Ohio.*

Dayton Rubber

THE MARK OF TECHNICAL EXCELLENCE IN NATURAL AND SYNTHETIC RUBBER

Glass-Reinforced Plastics

(*Concluded from Page* 107)

straight piece) or destroying it. An alternative is to make the part in two flanged pieces and cement them together. The flange can be placed at any point of maximum dimension for early removal from a permanent mold, *Fig.* 14.

Tolerances on vacuum molded parts of laminated construction are generally not as close as on parts made in closed molds. Such pieces can be made as precise as the molds over which they are formed, however, since the glass polyesters will generally shrink only in thickness during cure and not in the direction of the laminate layers. Thus a piece which must have accurate inside dimensions should be made over a male form and, conversely, accurate outside dimensions must be obtained by using a female form and dimensions should be indicated accordingly.

Thickness Tolerance Controllable

Tolerances on surfaces held against the mold during cure will generally be as close as the mold or form used. Thickness tolerance on vacuum molded pieces will generally be about ±10 per cent except where cloth overlapping occurs in the "lay up" in which case the variation will be greater. Where closer thickness tolerances are required in a small area this can frequently be obtained by externally located pressure blocks.

Surface finish of glass laminates is pleasing for the translucent plastic makes visible the texture of the glass reinforcement. Various thicknesses of glass fibers in many weaves of fabrics and several mat arrangements make possible decorative treatment. The molded material generally has an embossed surface pattern giving a texture similar to that of the woven glass material used. Many colors can be achieved through the use of dyes. If complete opacity is desired the plastic can be pigmented or the finished parts can be painted with any paint, lacquer or enamel, including those requiring baking.

Increases Bolt Strength

EFFECTIVE STRENGTH OF BOLTS may be increased as much as 40 per cent by use of tapered lips or threads, according to studies made by Dr. M. Hetenyi, Westinghouse research engineer. Dr. Hetenyi's conclusion is based on three-dimensional photoelastic analysis of plastic models. Bakelite bolts were fitted with nuts of the same material and loaded in the same way as they would be in service. Stressed models were then annealed and a good ⅛-inch longitudinal section removed from each. Stress lines and points were determined by the well known polarized-light technique. For a conventional bolt the ratio of maximum to average stress was found to be about 2.62. Tapered threads, however, decreased the ratio to as little as 1.55.

FOR A BETTER SOLUTION TO THESE 3 DESIGN PROBLEMS

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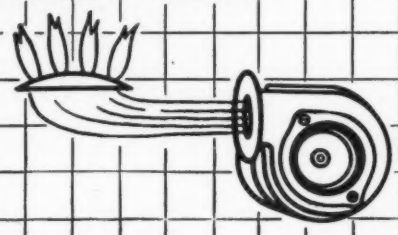
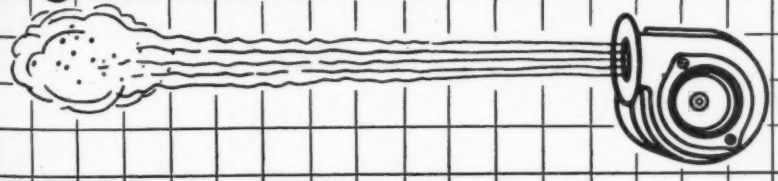


2 FOR HOT OR COLD AIR CIRCULATION

3 FOR EXHAUSTING DUST OR FUMES



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FASCO Motor Blowers are especially adaptable for heating and ventilating devices and for cooling electronic equipment. More and more designers are standardizing on these 15 to 140 C.F.M. units for distributing air in confined spaces.

FASCO Shaded Pole Blowers offer advantages proved by years of engineering experience . . . quiet, economical, trouble-free operation, and long life.

FASCO ENGINEERS ARE ALWAYS READY TO HELP WITH YOUR BLOWER PROBLEMS. SEND FOR CATALOG AND INFORMATION.

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FORMERLY *Pilot* MOTORS and BLOWERS

Fatigue-Test Data

(*Continued from Page* 117)

of the nature and phenomenon of fracture and flow.

One such project, in which the Sonntag fatigue machine was of considerable assistance, has been the determination of the effect of notches of variable radius on the impact strength. It was desired to test notch-bar specimens with notch radius varying to zero but no mechanical means of cutting the zero radius notch was found to be adequate. The only way of obtaining the desired type of crack appeared to be to purposely induce a small fatigue crack at the base of the notch.

A new fixture, *Fig.* 3, fitting into the standard bending fixture, was constructed to hold the small machine-notched impact specimens. The specimen was then subjected to large alternating bending stresses for several hundred cycles. After some experimentation, it was found that a microscopic crack could be induced at the bottom of the notch, thus effectively extending the machine notch of small radius into one of essentially zero radius. By varying the number of cycles, it was found possible to produce cracks of various depths. These depths were ascertained by removing each specimen from the fixture and subjecting it to close examination with a metallurgical microscope. Well over 100 specimens were tried and in all instances, fatigue cracks of the desired type were quickly and simply induced. *Figs.* 4 and 5 show two photographs of a typical fatigue crack and illustrate the uniformity of the crack depth across the specimen.

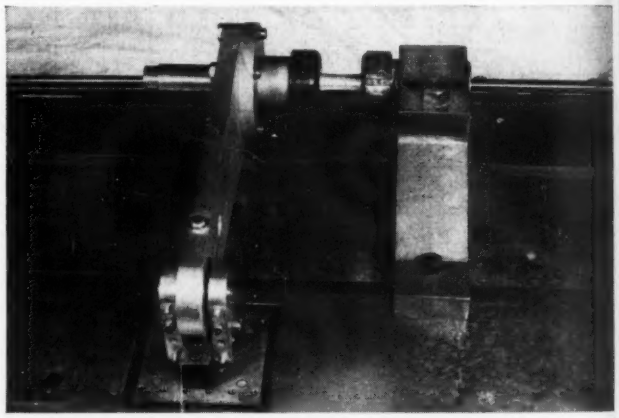


Fig. 7—Torsion fixture adapted for combined torsion and bending stresses

The effect of these induced fatigue cracks on other mechanical properties, in particular impact strength, are discussed by Zeno and Low[4].

FATIGUE UNDER COMBINED STRESSES: A third type of application in which the machine has been successfully used, and one probably more in line with

[4] Zeno & Low—"The Effect of Variation in Notch Severity on the Transition Temperature of Sheet Plate Steel in the Notched Bar Impact Test," *Research Supplement of the Welding Journal*, March, 1948.

the intended use of the fatigue apparatus, is for the study of fatigue characteristics of specimens subjected to alternating combined stresses. It was desired to test aluminum specimens in alternating torsion, in alternating bending and in various combinations of both alternating torsion and bending. In this manner, data would be obtained for determining which, if any, of the various theories of failure that have been proposed apply for aluminum specimens subject to principal stresses in the tension-compression quadrant.

In order to obtain data of this type, the standard bending fixture was adapted to accommodate round specimens, as shown in *Fig.* 6, so that the same shape specimen could be used for both the pure bending and pure torsion loading. Also, a new 15-inch arm was constructed as shown in *Fig.* 7 to permit application simultaneously of both torsion and bending loads. This fixture differed from the existing torsion fixture in that aluminum was used to cut down the dead load. Also, a new axle and bearing arrangement was required at the platen end to permit one additional degree of freedom in the direction of the specimen axis.

The new arm was so designed that it could be attached to either side of the collet holder. By so doing, different ratios of torsion to bending could be obtained. A 6-inch arm of the same design feature was also constructed and by use of this arm instead of the 15-inch one, still other torsion to bending ratios could be obtained. A typical fatigue S-N curve for the case of principal stress ratio of $S_2/S_1 = -\frac{1}{2}$ is shown in *Fig.* 8. In this diagram, the effect of the dead weight of the fixture which causes the mean bending stress to be other than zero is not included.

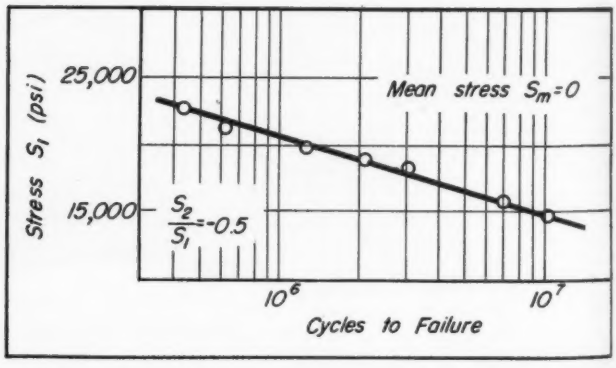


Fig. 8—Combined bending and torsion fatigue test for Alcoa 14ST using ¾-inch reduced diameter specimens

There is one serious disadvantage to the test setup as shown in *Fig.* 7. When the bearing block on the left end is removed so as to permit bending moments as well as torsional moments to be transmitted to the specimen, the dead weight of the fixture is no longer shared between the two pillow blocks and inertial forces of considerable magnitude are transmitted to the specimen. These forces can be calculated from the known mass of the vibrating parts and from their observed amplitudes and must be taken

DO YOU KNOW ABOUT THIS BEARING?

BRONZOIL — another Dodge "First"! Designed primarily for the exacting requirements of fan and blower service as well as for general service on small shafts. A *quality* bearing at lowest cost.

Its capillary bronze bushing has a capacity of one-third of its volume in oil. A liberal oil reservoir with close-fitting wick surrounds the bushing, provides complete lubrication.

An absorbent filler holds oil in the reservoir and prevents overlubrication. Self-lubricating bearing surface for the collar is provided by a shoulder on the bronze bushing.

Fully self aligning. Split pressed steel housing. Remarkably strong and thoroughly dependable, for quality products. Neoprene oil resistant grommets for insulation of sound are available. Write for special bulletin on Dodge Type "F" BRONZOIL bearings.

DODGE MANUFACTURING CORPORATION
Mishawaka, Indiana

Bronzoil BEARING
TYPE "F"

DODGE
of Mishawaka, Ind.

CALL THE TRANSMISSIONEER

He is your local Dodge Distributor — factory trained — qualified to suggest ways to improve your machine performance, increase production. Look for his name under "Power Transmission Equipment" in your classified phone book.

into account if a true S-N curve is desired.

To speed up the recording of test data, it would be desirable to eliminate the necessary computation of the inertial forces, by appropriate introduction of an inertia force compensating device. In principle, this should be similar to the preload springs currently used with the machine to eliminate the inertial forces of the moving elements attached to the reciprocating platen. Such a setup is, however, somewhat more complicated because the attached spring or springs not only must eliminate the dead-weight effect of the fixtures, but also must not interfere with the torsional rigidity of the system.

These three applications of the Sonntag fatigue machine indicate its versatility. Many more will suggest themselves as engineers and designers become familiar with the apparatus. It has already become an important asset of any modern vibrational laboratory and consideration of its possible use in other types of vibration problems would appear to be well worthwhile.

BUSINESS AND SALES BRIEFS

SUCCEEDING L. M. Klinedinst, who has retired, Whitley B. Moore has been elected vice president in charge of sales of the Timken Roller Bearing Co. Mr. Moore was previously director of sales for the company.

♦

With offices at 19 E. 47th St., New York, F. L. Sargeant has been appointed manager of the New York sales division of the Reynolds Metals Co. Mr. Sargeant succeeds Stuart Smith who has been appointed special representative to the United States Air Forces, with offices in Dayton, O.

♦

Marvel Engineering Co., manufacturers of Synclinal filters, has moved into new and larger quarters located at 625 W. Jackson Blvd., Chicago 6.

♦

Formerly sales manager of the Dynamotor Corp., Ralph S. Drummond has been appointed manager of the Cincinnati branch office of Crocker-Wheeler Electric Mfg. Co.

♦

Acquisition of the Pennsylvania Forge Corp. has recently been announced by Tube Turns Inc. James S. Kerwin, president of the Tacomy, Pa. organization, will remain at his post as will other officers and personnel. George O. Boomer, president of Tube Turns Inc. and its affiliate The Girdler Corp., will become chairman of the board of the newly acquired forging and machining facility.

♦

According to a recent announcement, E. G. Knox has been appointed one of two assistant sales managers of

the Ditzler Color Div. of Pittsburgh Plate Glass Co. Mr. Knox will assist William H. Hogben, industrial sales manager.

♦

Formerly sales manager of Standco Brake Lining Co., A. Ray MacPherson has joined Thermoid Co. as manager of its industrial friction materials sales division.

♦

Cornerstone of a million-dollar research building was recently laid by Sylvania Electric Products Inc. Located at Bayside, N. Y., the building will be one of a group of laboratories to be built for the projected Sylvania Research Center.

♦

Succeeding Lloyd C. Backart, who advances to the post of chairman of the board, George R. Brockway has been appointed sales manager of the Rapids-Standard Co. Inc. Mr. Brockway was formerly assistant sales manager and central regional sales manager.

♦

New plant has been placed in operation by the E. F. Houghton & Co. of Canada Ltd. Devoted to the manufacture of industrial oils and leathers, it is located at 100 Symes Road, Toronto.

♦

E. J. Geittman, for the past six years sales manager of the Fisher Furnace Div. of Lindberg Engineering Co., has joined the Carbonite Metal Corp. He is now serving as vice president and general manager of the Burlington, Wis., company.

♦

The Duraloy Co. of Scottdale, Pa., has announced the appointment of J. B. Dear as assistant sales manager.

♦

Purchase of the Los Angeles plant of Air Associates Inc. has recently been made by Parker Appliance Co. the new acquisition will enable the organization's Pacific division to double its production. Continuing as head of Pacific coast operations for Parker is H. E. Schroeder.

♦

Named manager of the Allis-Chalmers general machinery division's central region, P. F. Bauer will have his headquarters in Cleveland. His territory covers district offices in Cleveland, Toledo, Pittsburgh, Youngstown, Wheeling, Cincinnati, Detroit, Grand Rapids, and Jackson.

♦

Name of the American Foundrymen's Association has recently been changed to American Foundrymen's Society. Change has been made to conform with the function of the organization.

♦

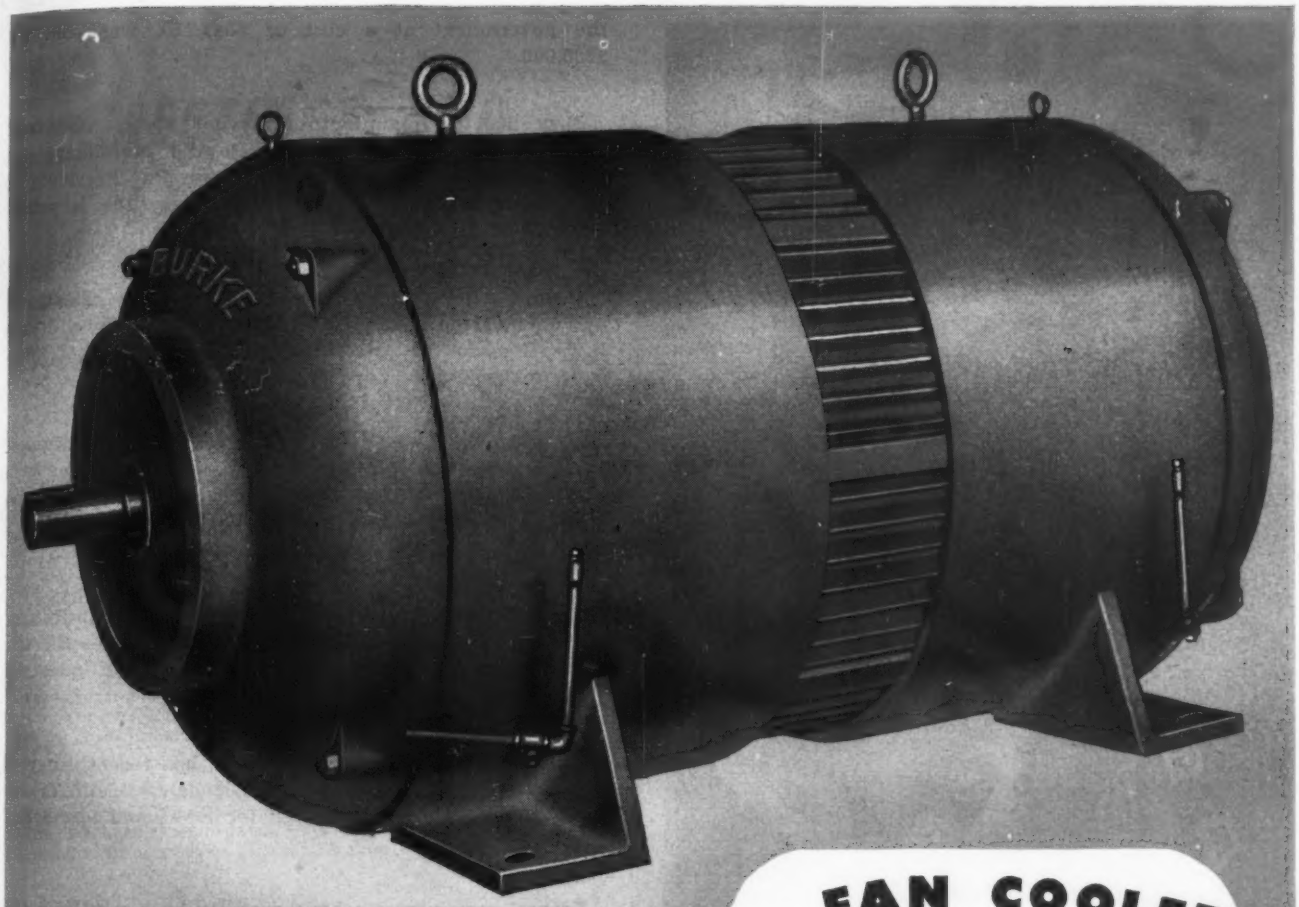
Kent Cliff Laboratories, Peekskill, N. Y. has appointed J. B. Verrier, Jr. in charge of sales. Mr. Verrier was formerly with Wilson Mechanical Instrument Co. Inc.

♦

Formerly director of advertising and publicity, Robert A. Morris has been appointed assistant to the president of the Acme Steel Co.

♦

Radio equipment plant at Newark, N. J. has been sold by the War Assets Administration to the Ralph C. Coxhead Corp. The plant, known as Titeflex Inc. and built by



TOTALLY ENCLOSED . . . FAN COOLED

THE above 350 H.P., 3600 R.P.M., Motor, is typical of the redesigned line of Burke large totally enclosed fan cooled squirrel cage induction motors. They are available in sizes 250 to and including 500 H.P. for direct driving high-speed blowers, pumps, compressors and like equipment installed under conditions involving dust, abrasives, conducting materials, or excessive moisture. These large motors are also available at 1800 and lower R.P.M. with either sleeve or ball bearings. Let's have your problem.

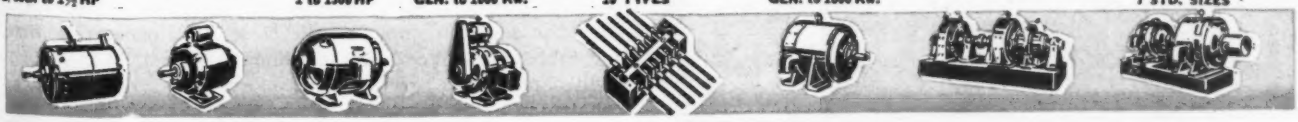
BURKE
350 H.P.
3600 R.P.M.

(Specs. for Above)

55°C Rise, Continuous
3-phase, 60 cycle, 440 volts
Full voltage starting
Starting torque.....70%
Pull out torque.....250%
Full load current..400 amps
Locked rotor current
2500 amps

BURKE ELECTRIC COMPANY 19810 W. 12th ST. ERIE, PA.

UNIVERSAL MOTORS 1/58th to 1½ HP
SINGLE PHASE MOTORS to ½ HP
INDUCTION MOTORS 1 to 1500 HP
SYNCHRONOUS MOTORS to 1500 HP GEN. to 1000 Kw.
TERMINAL BLOCKS 19 TYPES
D.C. MOTORS to 1500 HP GEN. to 1000 Kw.
M-G SETS to 1000 Kw.
HIGH CYCLE M-G SETS— 7 STD. SIZES



the government at a cost of $542,710, was sold for $335,000.

♦

New firm to manufacture powder metal parts will be known as the International Powder Metallurgy Co. The company is located at Ridgway, Pa. President is M. T. Victor, former sales engineer for the Keystone Carbon Co.

♦

George J. Fischer has been named manager of national accounts of the industrial products sales division of the B. F. Goodrich Co. Mr. Fischer had been product manager in the division for the last several years.

♦

New addition has been completed at the Milwaukee plant of Stearns Magnetic Mfg. Co. New building will house the administration division and engineering and laboratory facilities.

♦

Facilities of the Hynes Electric Heating Co. have been purchased by the Martin-Quaid Co., metal fabricators. The new acquisition will be known as the Hynes Electric Heating and Process Div. and will specialize in industrial heating problems.

♦

Furane Plastics and Chemicals Co. has recently moved its quarters to 719 W. Broadway, Glendale 4, Calif. Transfer was prompted by the need for additional space and facilities.

♦

Several appointments have recently been made by the Washington Steel Corp. These include John C. Richards as general manager of sales, Robert O. Fulton as assistant sales manager and S. M. McGough as sales representative.

♦

According to a recent announcement, Fred T. Miller has been appointed sales manager of Adel Precision Products Corp. Prior to occupying this position, Mr. Miller was west coast representative for the firm.

♦

Construction has been started on an addition to the building occupied by the Cook Research Laboratories, a division of Cook Electric Co. Addition will double the floor space available for design and development activities.

♦

Purchase of the Los Angeles plant of Air Associates Inc. has recently been made by Parker Appliance Co. the new acquisition will enable the organization's Pacific division to double its production. Continuing as head of Pacific coast operations for Parker is H. E. Schroeder.

♦

Recently affiliated with Wellman Bronze & Aluminum Co., Laurence J. White will serve as that company's Chicago area representative, with offices in the Uptown Bank Bldg.

♦

Succeeding H. L. Watson as president of the De Laval Steam Turbine Co., is George W. Smith Jr., formerly a vice president and director of the White Motor Co. and the senior member of the New York consulting firm of Smith and Wood Inc. Although retired, Mr. Watson will continue to serve the company as a director and as chairman of the executive committee.

MEETINGS AND EXPOSITIONS

Oct. 23-29—

American Society for Metals. Thirtieth annual convention to be held at Benjamin Franklin Hotel, Philadelphia. W. H. Eisenman, 7301 Euclid Ave., Cleveland 3, O., is secretary.

Oct. 25-27—

American Gear Manufacturers Association. Semiannual meeting to be held at Edgewater Beach Hotel, Chicago. Newbold C. Goin, Empire Bldg., Pittsburgh 22, Pa., is executive secretary.

Oct. 25-28—

American Institute of Mining and Metallurgical Engineers. Annual fall meeting of the Institute of Metals division to be held at Hotel Adelphia, Philadelphia. Ernest Kirkendall, 29 West 39th St., New York 18, N. Y., is division secretary.

Oct. 25-29—

American Welding Society. Annual meeting to be held at Bellevue-Stratford Hotel, Philadelphia. M. M. Kelly, 33 West 39th St., New York 18, N. Y., is secretary.

Oct. 25-29—

National Metal Exposition to be held in Commercial Museum and Convention Halls, Philadelphia. Chester L. Wells, 7301 Euclid Ave., Cleveland 3, O., is assistant managing director.

Oct. 27-28—

Society for Non-Destructive Testing. Annual convention to be held at Hotel Benjamin Franklin, Philadelphia. Philip D. Johnson, 53 West Jackson Blvd., Chicago 4, Ill., is secretary.

Nov. 3-5—

American Society of Body Engineers, Inc. Annual convention to be held at the Rackham Memorial building in Detroit. Additional information may be obtained from headquarters of the society at 100 Farnsworth Ave., Detroit 2, Mich.

Nov. 4-5—

Society of Automotive Engineers. Fuels and lubricants meeting to be held at Mayo Hotel, Tulsa, Okla. John A. C. Warner, 29 West 39th St., New York 18, N. Y., is secretary and general manager.

Nov. 4-5—

Metals Casting Conference to be held at Purdue University. Conference is sponsored, with the cooperation of the American Foundrymen's association, by the Dep't. of General Engineering, Purdue University, Lafayette, Ind.

Nov. 4-6—

National Electronics Conference to be held at Edgewater Beach Hotel, Chicago. R. R. Buss, electrical engineering dep't., Northwestern University, Evanston, Ill., is secretary.

Nov. 10-13—

Society of Naval Architects and Marine Engineers. Fifty-sixth annual meeting to be held at the Waldorf-Astoria, New York. Harold M. Wick, c/o American Bureau of Shipping, 45 Broad St., New York, N. Y., is chairman of the publicity committee.

Nov. 28-Dec. 3—

American Society of Mechanical Engineers. Annual meeting to be held at Hotels Pennsylvania and New Yorker, New York. C. E. Davies, 29 West 39th St., New York 18, N. Y., is secretary.

Nov. 29-Dec. 4—

Eighteenth National Exposition of Power and Mechanical Engineering to be held at Grand Central Palace, New York. Additional information may be obtained from the International Exposition Co., Grand Central Palace, New York 17, N. Y. Charles F. Roth is manager.

DESIGN ABSTRACTS

Specifying Cast Iron

FIRST consideration in preparing a specification for cast iron should be the establishment of the carbon level. Lower total carbon irons have a longer freezing range, that is, a longer range of temperature from the time that they have ceased to be purely liquid until they are completely solid. It is in this plastic or "mush" period that many of the difficulties with castings arise, and the narrowing of this period is obviously advantageous.

Shrinkage continues throughout this plastic period, but the iron "feeds" with great difficulty and, if proper feeding cannot be accomplished, many small voids are generated which are known as microporosity, or open iron. It can be seen that the narrower the plastic range the less the tendency for this condition.

By using high total carbon, the same matrix structure and hardness can be obtained at the higher carbon level as with the lower carbon, provided silicon is adjusted in the opposite direction by the proper amount. There is a distinct economic advantage in running relatively high total carbons. The necessity for feeding with external risers is reduced and castings generally are sounder.

Cost Factors

Since the engineer must ultimately be concerned with relative economies of producing different types of iron, he should know that in specifying high tensile strengths and low total carbons, he is directly affecting the cost per ton of iron poured. It has been the experience of the author that the percentage of yield can be improved from values as low as 65 per cent to as high as 85 per cent by a better selection of iron composition. In most cases this improvement need not carry a penalty of casting strength, although test bars may give a misleading high value in the former case.

Naturally the higher total carbon iron will contain more graphite. Lest this be considered a disadvantage it should be mentioned that leakage does not occur through graphite particles. Instead the low-carbon iron

Cut Your Costs by Redesigning for RETAINING RINGS

Gehl Harvesters and Hammer Mills are famous for their efficiency, rugged construction and continuous heavy duty service. By skillful designing for retaining rings Gehl Bros. Mfg. Co. of West Bend, Wisconsin saves metal, money and time. Perhaps you can too.

Hundreds of machines and products can and should be redesigned to take advantage of these inexpensive, yet highly efficient, artificial shoulders. Retaining rings are certain to save man hours as well as material.

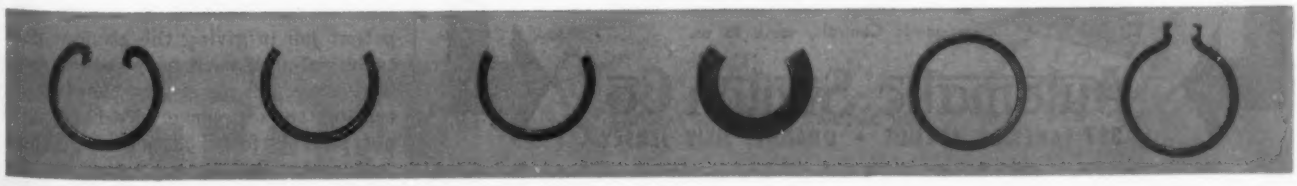
To offset the rising costs of so many things here is one sure way to increase your margin of profit.

Don't cut down large shafts to make your shoulders—it's needless waste. Groove all shafts and housings and use these high grade steel rings.

Examine your machines and products today, and send for a descriptive folder of our many types of retaining rings.

THE NATIONAL LOCK WASHER CO.

NEWARK 5, N. J. **MILWAUKEE 2, WISCONSIN**



of low graphite under a given set of conditions will usually show a greater tendency to microporosity than a relatively high carbon iron made with the proper amount of silicon, even though the graphite particles are more numerous. It is this microporosity which is usually responsible for leaks.

Because of an existing specification on brinell hardness, it is sometimes difficult to substitute the more advantageous higher carbon unless the engineer is willing to modify brinell hardness specifications. To indicate the fallacy of attempting to regulate the performance of an iron with respect to wear on the brinell basis, a 4.00 per cent total carbon iron showed a brinell hardness of 146, yet the micro-hardness of the pearlite between the graphite particles fell in the range of 226 to 255. This latter value is the load-carrying value of the iron. While it is true that this type of iron will show greater deformation under concentrated loads it is an excellent material where the unit pressures are well below the limit at which deformation begins. There are records on file of high graphitic irons showing many times the life, in resisting wear, of lower graphite irons of the same matrix structure. —*From a paper by R. G. McElwee, manager, Iron Foundry Division, Vanadium Corp. of America presented at the recent SAE summer meeting.*

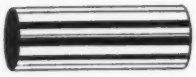
Characteristics of a Good Designer

ESSENTIAL characteristics that mark a creative designer must be generally known before effective educational programs attempting to develop these characteristics can be worked out. Surely any list of these qulities would include:

1. A strong curiosity
2. A broad fund of general knowledge
3. Good technical ability
4. Capacity to synthesize
5. Proper personal characteristics
6. Industrial experience.

Obviously the schools cannot be expected to furnish the student with industrial experience; just as obviously, the engineering schools in this country have been doing a very competent job in giving the student good technical ability. It is the other items that may not be given the full attention they deserve. Perhaps it is not possible to do justice to all these factors in the time allotted by the

The Old Way

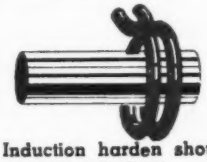


1 Start with 1⅝" round, 4½" long. Weight 2.64 lbs.

2 Stock: S. A. E. 1060 annealed for machinability.

3 Machine to 1.3780" diameter, except shoulder 3/32" wide and .111" high. .736 lb. of metal removed.

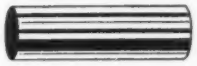
4



5 Induction harden shoulder to Rockwell C 62.

6 Grind shaft both ends.

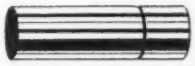
with RELIANCE RINGS



1 Start with 1.3780" round, 4½" long. Weight 1.89 lbs.

Saving .75 lb.

2 Stock: S. A. E. 1060, turned and ground.



3 Machine groove .105" wide and .045" deep. Approximately .004 lb. of metal removed. .732 lb. less metal to remove.

Note saving of machining.

4 Assemble ring in groove.

A simple operation.

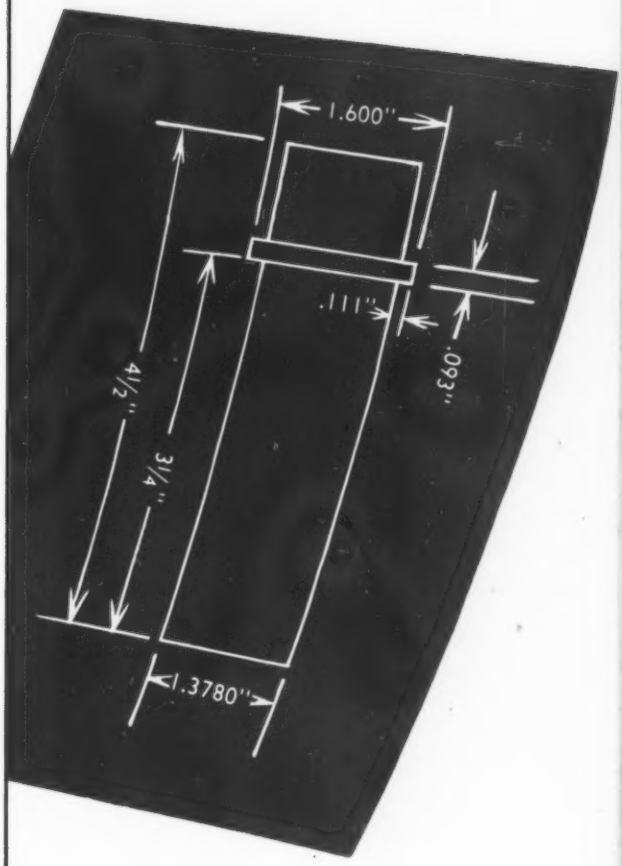
5 Ring already hardened.

No heat treating necessary.

6 Shaft already ground.

No grinding necessary.

Assembly has ultimate shear strength of 37,000 lbs., when snap ring and shaft are of the same hardness. Will withstand pressures in excess of 5000 lbs.



are there any *Savings like this* in your product?

The illustration shows a common cost-cutting application of Reliance Rings in the production of shouldered shafts. They may also be used to produce shoulders in bores.

Made from carbon, alloy or stainless steel, or non-ferrous metal to specified physicals . . . of any desired cross section and diameter . . . welded or open with ends shaped to meet any requirement . . . Reliance Rings offer limitless possibilities for reducing costs, speeding production and improving product performance.

DESIGN ENGINEERS - PLANT OPERATING MEN — Let Reliance Engineers help you reduce costs through the use of Reliance Rings in your product production. Write today.

RELIANCE SPRING LOCK WASHERS

— in American Standard sizes — compensate for looseness of bolted parts. Keep bolted assemblies tighter longer.

EATON SPRINGTITES

The all-in-one unit, quality spring lock washer pre-assembled on a bolt or screw. Cuts production cost by increasing production efficiency.

EATON

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usual engineering curriculum, but certainly an effort to do so should be made, since even a little "plus" will often make the difference between the success or failure of a design.

Curiosity is of paramount importance in solving specific problems, and in leading the designer to new applications and new products. The defining of the problems associated with a specific design is based upon questions about the design that are inspired essentially by curiosity. Questions such as "why do it this way instead of that?" or "what happens under this set of circumstances?" are integral with the design process.

Absorption of Knowledge

Besides helping on specific problems, a strong and active curiosity is an excellent self-teacher. The curious individual will continue to absorb knowledge from the men and machines around him, and will constantly increase his fund of knowledge. For the ideal designer, this background should include information concerning phenomena, and an acquaintance with ways of doing things well outside of his major field of endeavor.

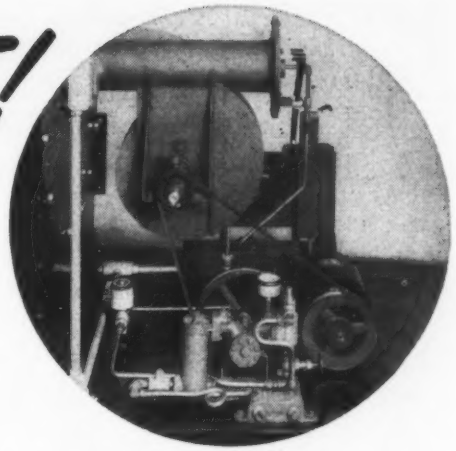
Synthesis is possible when curiosity and background are combined with technical ability and good personal characteristics. An intriguing example of this type of synthesis is seen in the mechanical pen on a direct-recording oscillograph. The mechanical magnification of this pen is on the order of 400 to one, and the total weight is probably two grams. It must have been made by a designer who had in his general background a knowledge of the principles of operation of a chain hoist, sufficient curiosity to wonder if he could make a small chain hoist and run it backwards, and sufficient technical ability to carry out his ideas.

Confidence or a belief that a problem can and will be solved is one of the essential personal characteristics of the ideal designer. Naturally, this confidence must be associated with the necessary determination and drive to carry the project through the tough spots. In addition, if the designer is to be outstanding, he must have the ability to appreciate the position of others, so that he will display the consideration and tolerance vital to group effort.—*From a paper by E. L. Midgette, J. N. Macduff, and J. Modrovsky, Polytechnic Institute of Brooklyn, presented at the recent annual meeting of the American Society for Engineering Education.*

EASY — 10° FLARE — DOES IT!

Would you switch to light wall tubing if you could obtain fittings that withstand vibration under high pressure?

Then you'll be interested in Superseal Flared Tube Fittings which are now standard equipment on steam generators and on air compressors with pressures running up to 600 P.S.I. The same fittings which in an Underwriters' Laboratories' test maintained a leakproof joint under pressures up to an amazing 8090 pounds, at which pressure the steel tubing split.



Superseal fittings are standard equipment on Cleaver-Brooks Steam Generators.

Superseal fittings can be used with any tubing . . . copper, aluminum, seamless and welded steel.

Check these Superseal features

✓**LONG, SMOOTH TAPERED 10° FLARE** on a Superseal fitting plus a corresponding flare on the inside of self-aligning nut hold tubing securely in place.

✓**NO SHEARING ACTION** to injure the tubing at the point of flare when nut is tightened—the tubing is actually reinforced.

✓**TWO PART FITTING** . . . no rings. no sleeves.

✓**PRODUCTION FLARING** up to 2000 a day can be maintained on an inexpensive flaring machine.

✓**STOCKED IN BRASS AND STEEL.** Malleable iron, aluminum or alloys on order.

✓**SUPERSEAL** Fittings are approved by Underwriters' Laboratories for all hazardous gases and liquids. Write for Catalog 4-R "Grinnell Superseal Flared Tube Fittings."

Production flaring of tubing up to 2000 flares a day is possible with this flaring machine. A simple tool is available for hand flaring.

GRINNELL COMPANY, INC.
Providence 1, R. I.

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Atlanta 2, Ga.
Charlotte 1, N. C.
Chicago 9, Ill.
Cleveland 14, O.
Cranston 7, R. I.
Fresno 1, Cal.
Houston 1, Tex.
Kansas City 16, Mo.
Long Beach 10, Cal.
Los Angeles 13, Cal.
Milwaukee 3, Wis.
Minneapolis 15, Minn.
New York 17, N. Y.
Oakland 7, Cal.
Philadelphia 34, Pa.
Sacramento 14, Cal.
St. Louis 10, Mo.
St. Paul, Minn.
San Francisco 7, Cal.
Seattle 1, Wash.
Spokane 15, Wash.

GRINNELL
FOUNDED 1850
WHENEVER PIPING IS INVOLVED

NEW MACHINES

And the Companies Behind Them

Bottling

BOTTLE AND JAR DRIER. Bottles are worm fed; protected by safety gate. Water is blown from bottles by air blast. Aluminum shield and catch pan collect water. Barry-Wehmiller Machinery Co. St. Louis 15.

FILLING MACHINE. Siphon gravity type for bottles, jugs and cans. Handles wine, disinfectants, insecticides, water-soluble floor waxes, cleaning solutions, etc. Automatic inlet valve controls volume of liquid. Liquid reservoir fully enclosed under one-piece metal hood. Reservoir drains self dry, facilitating change from one liquid to another. Scientific Filter Co., New York 7.

Communication

SOUND RECORDER. Records conversations, interviews, reports, two-way telephone conversations, dictation, etc., permanently on safety film. Large reel has total recording capacity on both sides of 200 hours. Machine measures 4 by 8 by 9 inches; weighs 11 lb. Miles Reproducer Co. Inc., New York 3.

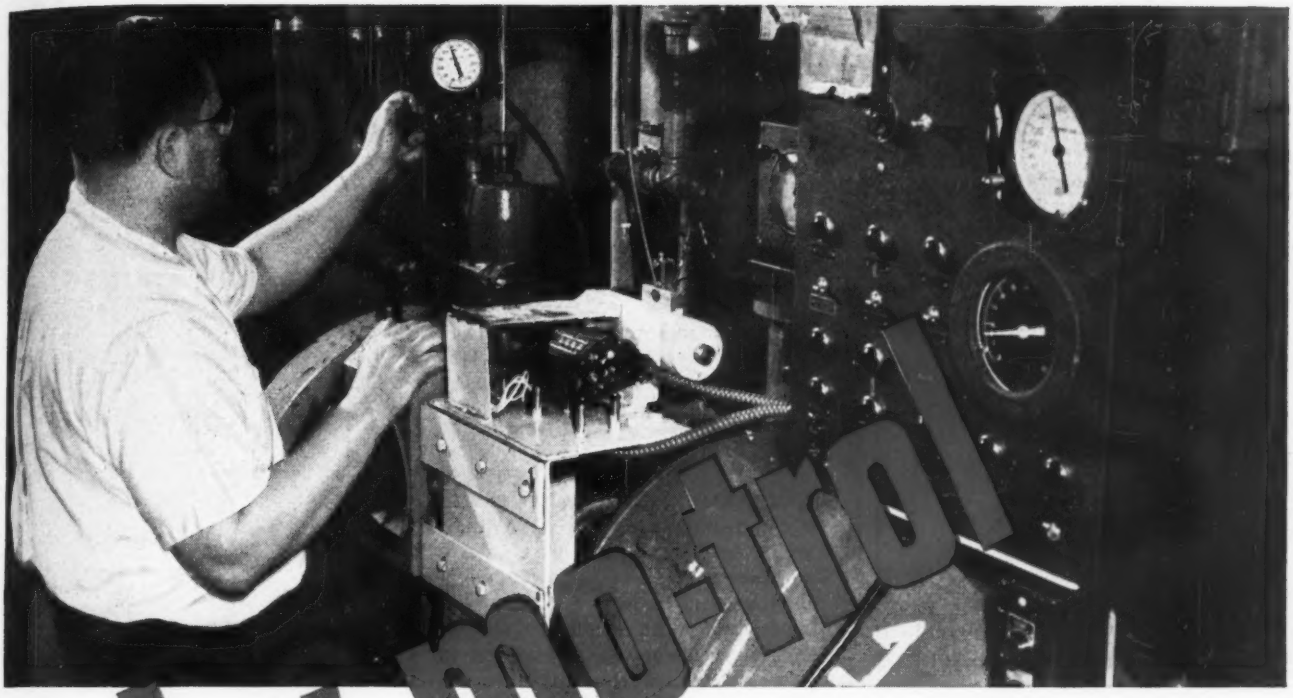
SOUND RECORDER. Used with standard 16-mm. silent movie projector. Indents sound grooves on film between sprocket holes and picture frames. Synchronizes sound with picture projected. Machine measures 4½ by 8 by 9 inches; weighs under 10 lb. Miles Reproducer Co. Inc., New York 3.

Heat Treating

CONTROLLED ATMOSPHERE FURNACE. For hardening high-speed and air hardening steels and for brazing and sintering operations. Operates at temperatures to 2500 F. Propeller type fan at top of cooling chamber circulates protective atmosphere within chamber, provides fast, uniform cooling. Charge and discharge door operated by air cylinders. Lindberg Engineering Co., Chicago 12.

SALT BATH UNIT. Continuous. Uses neutral or cyanide type salts, for hardening small parts. Comprises two pot type furnaces, a quench unit, a wash unit and a dryer, plus automatic handling equipment. Charges range from 100 to 125 lb. Dempsey Industrial Furnace Corp., Springfield, Mass.

ELECTRIC FURNACES. Bench type. For laboratory uses and heat treating. Six sizes. Operate to 1650 F for continuous use; to 1900 F for short periods. Nickel-chromium heating



"thy-mo-trol gives us uniform tests"

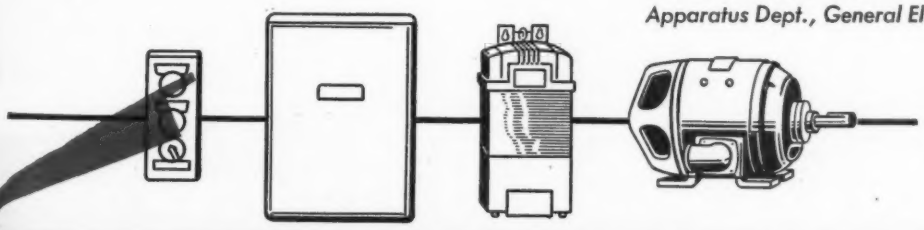
—says the American Bosch Corporation, of Springfield, Mass. "The fuel injection equipment we make for all types of diesel engines must be accurately tested under conditions of power and speed met in actual operation. Thy-mo-trol drives in our plant assure us of accuracy wherever close speed regulation and wide speed ranges are required."

Thy-mo-trol guarantees constant speed

Each cylinder in each full injection pump is tested to see that it delivers the correct amount of fuel at different metering control settings and at different strokes per minute. Thy-mo-trol maintains constant speed regardless of change in temperature and viscosity of oil. It's the same on every Thy-mo-trol application at this plant. American Bosch has found that Thy-mo-trol provides close speed regulation, versatility, and speed variation needed for each application.

Thy-mo-trol can save time and money for you, too

Designed to provide the advantages of a d-c motor drive on a-c power, Thy-mo-trol will give long, uninterrupted service on machine tools, conveyors, blueprint machines, hosiery machines, and many other places where smooth, stepless speed control, pre-set speed control, speed regulation, or dynamic braking are required. Standard drives range from ¼ to 30 horsepower. Special sizes can be built to order. Here is a packaged system, that may answer your speed control problems. Write for more information in the following bulletins. *Apparatus Dept., General Electric Co., Schenectady 5, N. Y.*



Thy-mo-trol Drive

GEA-4849, ¼ to ½ hp
GEA-4714, ¾ to 7½ hp
GEA-4847, 10 to 30 hp

THE RIGHT SPEED FOR EVERY JOB WITH THY-MO-TROL DRIVE

GENERAL ELECTRIC

676-208

elements embedded in refractory plates. Up-lifting counterbalanced doors. Bodies are welded steel with dual insulation. Indicating pyrometer, pilot light, toggle switch and stepless input controller in instrument panel. Thermo Electric Mfg. Co., Dubuque, Iowa.

Hotel

SILVER WASHER AND DRIER. Washes, rinses, sterilizes and dries silverware automatically. Ware loaded into cast aluminum drum which rotates while detergent, water and fan-blown hot air are automatically cycled. The Foley-Irish Corp., Brooklyn 1, N. Y.

Industrial

STEAM CLEANER. Portable, all electric. For cleaning shop walls, ceilings, windows, fixtures, etc. Steam, soap solution, solvent or detergent combine at nozzle and are atomized, impinging at high velocity on surface to be cleaned. Pressure tank assures positive flow of detergent or solvent to nozzle. Unit weighs 400 lb; is mounted on all-steel dolly with ball-bearing, rubber-tired swivel casters. Livingstone Engineering Co., Worcester 5, Mass.

Manufacturing

SCREW DRIVERS-NUT SETTERS. Low-speed, high torque, air driven. Twelve new models range from 450 to 1100 rpm. Choice of positive or friction clutch. Suspension bale furnished on all lever models. The Aro Equipment Corp., Bryan, O.

PORTABLE ELECTRIC DRILLS. Eight models from ¼ to ⅞-in. capacity, all equipped with "K-O" keyless drill chucks. K. O. Lee Co., Aberdeen, So. Dakota.

UTILITY BENCH GRINDER. Fully-enclosed, dynamically balanced motor of permanent split-capacitor type. Two grinding wheels, fine and coarse, adjustable tool rests and abrasive wheel dresser. K. O. Lee Co., Aberdeen, So. Dakota.

BAND SAW. 16-inch; for cutting plastics, wood, cardboard, leather and sheet metal. Pressed steel housing encloses all working parts; arc welded frame. Built-in sawdust chute emptied from front. Drive wheels are balanced cast aluminum, neoprene tired, mounted on ball bearings. Saw-blade tension indicator calibrated for different saw widths. The DoALL Co., Des Plaines, Ill.

Materials Handling

FORK TRUCK. Gas powered; 2000-lb capacity. Hydraulic lift-and-tilt control lever raises or lowers forks and tilts load forward or backward in any combination of simultan-

You Can Improve Cam Action Applications With

McGILL MULTIROL CAM FOLLOWER BEARINGS

Compared to plain bearings or ordinary ball bearings, the MULTIROL CF Series cam follower units carry heavier loads longer . . . with greater efficiency and with less maintenance cost.

They are adaptable to higher speeds because of precision tolerances on all dimensions.

Specify the MULTIROL Cam Follower for design and performance extras that improve cam actioned automatic operations on printing presses, packaging machinery, lathes, automatic screw machines — in fact all types of automatic machinery. Also adaptable to guide and support roller applications such as mast rollers on lift trucks.

** Available now at ordinary needle bearing prices.

McGILL
TRADE MARK
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CF series

Bulletin CF-40A offers complete CAM FOLLOWER data. WRITE for it TODAY. Address: McGILL MANUFACTURING COMPANY, INC., 200 N. Lafayette St., Valparaiso, Indiana.

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precision bearings

eous movements. Automatic fork stop at max. lift height. Powered by 4-cylinder, water-cooled engine. Double-shoe hydraulic brakes lock automatically when driver leaves seat. Tract-R-Lift Corp., Chicago.

Merchandising

WIENER WARMER. Electronic. Heats wieners to palatable temperature in less than ten seconds. Uses 2.5 kw alternating current converted to radio frequency by oscillator tubes operating with 3000 volts direct current supplied by standard rectifier tubes. Pair of special relays protect tubes and circuits against overloads. Electronic Chemical Engineering Co., Los Angeles.

Metalworking

SHEAR. High speed; rated to 14-gage mild steel. Fingertip control of stroke. Handles pipe work, pans, channels, tubes, shells, etc., within limits of 7-in. throat. Weighs 100 lb including ¼-hp motor. Direct-coupled drive. Federal Machinery Co., New York 13.

SPECIAL-PURPOSE MACHINE. For center drilling and facing automotive pistons; 444 pistons per hour at 85 per cent efficiency. Two hydraulically actuated slide units carry single spindle heads for center drilling. Facing slides and tool blocks mounted on face of machine column, are hydraulically actuated in horizontal position. Spindles and chucks driven through V-belts. Snyder Tool & Engineering Co., Detroit.

FILING MACHINE. Reciprocating, bench type. Files, saws, laps, without changing overarms. Spring tension on saws and thin files adjusted by moving overarm chuck assembly up or down. Ball-jointed lower chuck permits perfect alignment of files with warped, crooked or twisted shanks before clamping in position. Work table tiltable 15 degrees in four directions. Rice Pump and Machine Co., Milwaukee.

HONING MACHINE. Small size, single-spindle, hydraulic. For honing any type internal cylinder from ½ to 4 in. diam. Max. honing stroke, 12 in. Reciprocation by hydraulic cylinder from 0 to 80 fpm; reciprocating mass hydraulically counterbalanced. Three spindle speeds. Pushbutton controls on front of machine. A. Allen Fulmer Co., Cincinnati 2.

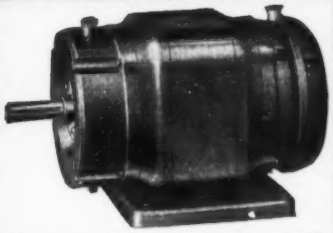
SHAPE CUTTING MACHINE. Flame cuts from steel templets through magnetic tracing device. Cutting range: to 42-in. diameter circle; straight lines to 89 in. long. Cast aluminum arms swing torch and control unit over work. Ohmstede

Streamcooled
TRADE MARK

MOTORS

ARE 100% TOTALLY ENCLOSED ...yet they can't clog and cause trouble

Streamcooled, round frame, 1/3 to 3/4 h. p., 1 phase, 3 phase and direct current.



Streamcooled face mounted; Single phase 1/3 to 7½ hp., Three phase 1/3 to 20 hp., Direct Current 1/3 to 3 hp.

Streamcooled, single phase, 3/4 to 7½ h. p.

Streamcooled, three phase 3/4 to 20 hp.

Many motors are actually choked to death!

But never a BALDOR STREAMCOOLED Motor.

Conventionally designed motors, with air passageways, constantly draw in dust, dirt, lint and all sorts of foreign matter.

Then the motor becomes "choked" and loses its efficiency, heats up and soon goes dead.

Such motors require frequent dismantling for cleaning . . . wasting servicing time and often slowing up or stopping production.

BALDOR STREAMCOOLED Motors *can't* inhale dust, dirt, lint or foreign matter because they are *totally enclosed* . . . non-clogging . . . cool-operating . . . because the outer-mounted fan forces air over the entire EXTERIOR of the motors.

BALDOR ELECTRIC COMPANY · ST. LOUIS, MO.

District Offices in Principal Cities

Baldor
BETTER MOTORS
FOR MORE THAN A QUARTER OF A CENTURY

Machine Works, Beaumont, Texas.

AUTOMATIC RAILROAD AXLE LATHE. For rough or finish turning wheel seat and journal diameters of railroad axles. Hydraulically operated chucking, clamping, feed and traverse movements. Pushbutton controls at each end of machine. 1000 lb of chips per hour removed by automatic chip conveyor. Morey Machinery Co. Inc., New York.

Plastics

PLASTIC GRANULE PREHEATER. Granules hopper fed to vibrating steel trough, granule feed rate being adjustable. Twelve infrared lamps heat material and trough from above. Temperature range, 70 to 400 F. Granules are preheated and dried. The Miskella Infra-Red Co., Cleveland 4.

Production

WEIGHING SCALES. 75-lb. capacity. Mechanical or electrical shadow indication. Three platter designs. Beams mounted at angle of 25 degrees to vertical to facilitate reading; 64 or 100-notch graduations. Lever fall, 3/32-in. Self-aligning bearings and pivots, with extra long bearing surfaces. The Exact Weight Scale Co., Columbus 12.

Testing

DRILL TESTING MACHINE. Heavy-duty, hydraulic. Single-spindle, 7-speed geared head. 30-hp motor maintains synchronous speed; as load builds up to predetermined value a torque limiting device stops motor. Shear pin protects gears. Forty-two speeds through change gears. The National Automatic Tool Co., Richmond, Ind.

ELECTRICAL TESTING UNIT. Conventional prod type; inductometer principle. Automatic test light. No tools or disconnects required; hydrometer readings unnecessary. Fay Darling and Co., Kansas City 2.

COIL SPRING TESTER. Handles loads to 5 lb and spring lengths to 12 in. Compression head surfaces are replaceable and are hardened steel, ground, lapped and chrome plated. Tension hook is ball mounted. Overload spring prevents damage from excess load or shock. Machine weighs 41¾ lb. Hunter Spring Co., Apparatus Division, Lansdale, Pa.

HYDROSTATIC TESTING MACHINE. For pressure testing (to 20,000 psi) of tubing. Seals end of tubing without perceptible flare, eliminates air, and builds up required pressure. Time cycle, load and unload, is approx. four seconds. Electrical panel is integral with base. Steel City Testing Machines. Inc., Detroit 4.

Directory of Materials

Fifteenth Edition

Devoted exclusively to tradenamed engineering materials which are used for fabrication into machine parts, this directory is the result of a careful and complete survey of the materials producing field. Presented in thumb-nail sketch form, individual listings are confined to information that will help the designer in evaluating materials for machine parts.

To facilitate quick spotting of materials, the directory contains only three major listings: The first presents materials by tradenames in alphabetical order and includes brief data on properties, characteristics and representative machine applications. The second, an index by types, is particularly useful for finding and comparing similar materials, or for selection based on alloy constituency. Lastly, the alphabetical listing of producers of materials gives complete addresses along with tradenames and types of materials each company produces.

Stainless steels, in addition to being listed in the tradename section, are presented in a separate listing. This listing presents brief data on properties, characteristics, uses and forms, and is accompanied by a list of producers, types and forms of stainless produced and their tradenames.

Many new metals, plastics and nonmetallics are included in the current directory. In addition, listings from previous issues have been revised and brought up to date. Every attempt has been made to make this edition a thoroughly reliable reference for the designer in his selection of modern materials.

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Standard Stainless Steels 281

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Stainless Steels—Tradenames and Producers 282

Tradenames, producing companies, and types and forms of stainless available.

Index of Materials by Type 283

Cross index for comparing similar materials and for selection based on major alloy constituents.

Materials Producers 287

Names and complete addresses of producers along with types and tradenames of materials produced.

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Additional copies of this directory are available at one dollar each. Orders should be sent to Readers Service Department, MACHINE DESIGN, Penton Bldg., Cleveland 13, O., and a 3% state tax included for orders originating in Ohio.

Materials Listed by Tradenames*

All types of materials used for fabrication into machine parts are listed alphabetically by tradename. Each listing includes type of material, name of producing company, material analysis, and brief data on properties, characteristics and representative machine applications

(For listing by producing companies and complete street addresses, see Page 287. For index of materials by type, see Page 283)

A

ABK METAL (Alloy steel castings) — Brake Shoe & Castings Div., American Brake Shoe Co., New York.

Ni-Cr alloy steel furnished as sand castings to specification. Ts, 55-80,000 psi; elong in 2 in., less than 0.5 per cent; Bhn, 550-750; magnetic; weldability, poor, abrasion resistance, very high. Used where castings are subject to severe abrasion and where intricate machining and high impact are not encountered.

ABRASOWELD (Welding electrode) — Lincoln Electric Co., Cleveland.

Arc-welding electrode for providing abrasion-resisting, self-hardening deposit which hardens repidly under impact and abrasion; maximum hardness develops at surface, leaving cushion of softer metal beneath. Provides resistance to abrasion in straight carbon, low-alloy or high-manganese steel surfaces; effective on gear and pinion teeth.

ACADIA (Synthetic rubbers)—Acadia Synthetic Products Div., Western Felt Works, Chicago.

Synthetic rubber compounds to meet Army, Navy and AMS specifications in sheets, extrusions and molded parts.

ACCOLOY (Stainless steel castings) — Alloy Casting Co., Champaign, Ill.

Analysis ranges from 18% chromium, 8% nickel to 68% nickel and 18% chromium. Furnished in castings. It is nonmagnetic, and heat resistant to 2300 F. Weldability, good; abrasion resistance, low. Used for corrosion-resistant applications such as pump parts, tubing, chemical processing furnaces, etc., where resistance to corrosion and/or high temperature is required.

ACE (Hard rubber)—American Hard Rubber Co., New Nork.

Hard rubber; thermosetting; furnished in sheets, rods or tubes and molded parts; may be machined, molded or extruded into parts; moisture absorption, low; abrasion resistance, medium; chemical restance, excellent in most acids, alkalies and salt solutions; attacked by strong oxidizing solutions; flexibility, medium; ts, 5-9000 psi; comp str, 12,000 psi; dielectric str, 475 volts per mil; flexural str, 15,000 psi, elongation, 3-6 per cent; color range limited; high shock resistance; opaque; sp gr, 1.18-1.2; rockwell HR 95.

Heat-resistant hard rubber; furnished in sheets, rods or tubes and molded parts, for molding, extruding and machining; abrasion resistance, medium; chemical resistance, excellent in most acids, alkalies and salt solutions; attacked by strong oxidizing solutions; flexibility, low; dielectric str, 400 volts per mil; ts, 5-6500 psi; comp str, 10,000 psi; flexural str, 8-10,000 psi, elongation, 1-3 per cent; moisture absorption, low; color range limited; opaque; sp gr, 1.65-1.8; medium shock resistance, machinability, fair. Both used for handles, caster wheels and special molded parts.

ACE SARAN (Vinylidene chloride plastics)—American Hard Rubber Co., New York 13.

A thermoplastic furnished in the form of sheet, rods and tubes. Abrasion resistance, medium; is resistant to most inorganic and organic chemicals and solvents; max cont serv temp, 175 F; flexural str, 15-17,000 psi; dielectric str, 350-400 volts per mil. inst.; ts, 4-7000 psi; impact str (Izod), .3 to 1.0 ft-lb; produced in the colors black, straw color, red and brown; moisture absorption, .1%; sp gr, 1.7; is translucent; machinability, good; hardness, Rockwell M 50—M 65. For oil lines, air lines fittings, insulations, bushings, grommets, valve parts, etc.

ACIPCO (Cast irons and steels)—American Cast Iron Pipe Co., Birmingham 2, Ala.

Sand castings and permanent-mold castings of plain cast iron, alloy cast iron, Ni-resist, Ni-hard, plain carbon steels, and all grades of alloy steel including stainless.

ACME STRIP (Strip steel)—Acme Steel Co.; Chicago 8, Ill.

Hot and cold-rolled strip steel; furnished in sheets and strips (coiled) for stamping into parts. Material is furnished to specification and is available in most sizes from ¼ to 22 in. in width and in thicknesses ¼-inch and less.

ACORN (Babbitt metal)—A. W. Cadman Mfg. Co., Pittsburgh.

Babbitt metal furnished in ingots; Bhn, at 70 F, 23.8; at 212 F, 21.8; comp str, 12,500 psi. For bearings having reciprocating motion, subject to excessive pounding or vibration.

ADAMANT SUPER-GENUINE (Babbit)—Magnolia Metal Co., Elizabeth, N. J.

Over 90 per cent tin, free of lead, containing special fluxes; furnished as ingots; sp gr, 7.34; bearing properties, good; bhn, untreated, 23. Used for bearings, diesel engines, connecting rods, etc., subject to shock or strain.

ADAMANTINE (Special cast steel)—The Babcock & Wilcox Co., New York 6, N. Y.

Special wear resistant steel castings. Machinable. For grinding mills, mixers, conveyors, power shovels, etc.

ADNIC (Copper-nickel alloy)—Scovill Mfg. Co., Waterbury 91, Conn.

Patented alloy of the copper-nickel group containing a controlled tin content of 1%, Ni 29-23, Sn 0.75-1.25, Cu remainder; available in strip. Has excellent corrosion resistance characteristics against many dilute minerals and organic acids, alkalies and salt solutions. Ts, 90,000 psi (hard); density, 0.322 lb cu in.; recommended annealing temperature range 1200-1560 F (650-850 C).

ADVANCE (High copper-nickel alloy)—Driver-Harris Co., Harrison, N. J.

Cu 55, Ni 45; thermocouple material. For applications where low-temperature coefficient of resistivity is required; such as in measuring instruments, industrial and radio rheostats and elevator controls.

AERISWELD (Welding electrode)—Lincoln Electric Co., Cleveland.

Arc-welding electrode; for welding of bronze, brass and copper, either in manufacturing or maintenance work.

AERTITE (Rubbery asphaltic-asbestos material)—Johns-Manville, New York 16.

Furnished in soft plastic form. Used on mechanical equipment to prevent air infiltration.

AETERNA 600 (Copper-zinc alloy) — Mueller Brass Co., Port Huron, Mich.

Cu 60, Zn 38 and balance of Mn, Si and Al. Furnished in finished rods or bars, tubing, and in forgings, for extruding and hot forging. Ts, 85-90,000 psi; nonmagnetic; weldability, good; abrasion resistance, low. For bearings, gears, cams, levers, etc.

AFCOLOY METAL (Cast iron)—The Atlantic Foundry Co., Akron 4, O.

Cast iron to specification; ts, 42,000 psi; comp str, 192,000 psi; impact str (Charpy), 7.5 ft-lb; bhn, 210; is magnetic; machinability, good; weldability, fair. Used primarily in the oil refinery machine field for liners, cylinders, dies, rams, etc.

AFIRON (Gray iron)—Terre Haute Malleable & Mfg. Corp., Terre Haute, Ind.

Produced in sand castings to suit specifications; in untreated state, ts, 30-50,000 psi; bhn, 207-260; is magnetic; weldability, good when preheated at 700 F.

AGALOY (Tubing)—Agaloy Tubing Co., Springfield, O.

Welded and seamless tubing of carbon steels SAE 1010 to 1095, alloy steels SAE 4130 to 4150, SAE 6115 to 6195 and SAE 52100. Also redrawn copper-brazed tubing of SAE 1010 carbon steel.

Cold-drawn welded tubing of stainless steels AISI types 304, 316, 317, 321, 329, 347 and 430. Cold-drawn seamless tubing of stainless steels AISI types 304, 308, 316, 317, 321, 347, 410, 430 and 446. For property and application data, see "Stainless Steels" listing at end of this section.

Monel, Inconel and nickel tubing for applications requiring high resistance to corrosion, oxidation and scaling, combined with good strength at high temperatures, good ductility and impact strength at low temperatures.

Composite tubing made up of two or more different metals to specification.

AGILE (Arc welding electrodes) — American Agile Corporation, Cleveland 3, Ohio.

Agile White electrodes; coated mild steel, furnished in rod. For welding mild steel and low alloy steel. Ts, 70,000 psi; ys, 60,000 psi; Bhn, 160. For welding of ships, boilers, pipe lines, requiring a high quality

*The manner in which the tradenames and trademarks are set up or catalogued in this directory shall not be construed as denoting them generic or free for general use.

weld deposit.

Red-White electrode; mild steel; furnished in rods; used for welding mild steel and low alloy steel in single or multiple pass fillet production and fabrication welding, even on poorly fit-up assemblies. Ts, 70,000 psi; ys, 60,000 psi; Bhn, 160. Meets AWS classification E-6012.

Blue-Red electrode; mild steel; furnished in rods; for joining mild steel and low alloy steel. Ts, 70,000 psi; ys, 60,000 psi; Bhn, 165. An all-position ac electrode recommended primarily for low open-circuit voltage transformers, as well as for general ac fabrication welding. Meets AWS classification E-6013.

Agile Brown electrodes; coated mild steel. Meets AWS classification E-6013. Furnished in rod form. For welding thin and medium-heavy gage steel sections. Ts, 68,000 psi; ys, 60,000 psi; Bhn, 160. Used for welding automobile bodies, truck and bus bodies, air conditioning equipment.

Blue-Gray electrode; mild steel; furnished in rods; for joining mild steel, low alloy steels, cold rolled and medium carbon steels. Ts, 60,000 psi; ys, 60,000 psi; Bhn, 160. A semi-automatic (drag-type) electrode, furnishing high-quality, x-ray dense, weld metal of excellent appearance, meeting AWS classification E-6020.

Hardface electrode; three different carbon-chromium-molybdenum alloy steels, composition depending on final hardness desired. Furnished in rods; Bhn range, 250-600. For rebuilding machine surfaces exposed to wear, impact, slight corrosion, and requiring various degrees of hardness.

Toughface; a heavy coated manganese nickel electrode; furnished in rods; Bhn ranges from 200-500. The weld deposit work hardens rapidly and is extremely resistant to impact and abrasive wear. Used for refacing of crushing and grinding equipment, railroad frogs, switches, etc.

Yellow-M; a heavily coated copper-nickel alloy; furnished in rods; for joining cast iron; Bhn, 160. For repairing and refacing cast iron machine parts, where machining after welding is required.

Yellow-Ni; a heavily coated nickel-core electrode; furnished in rods; for welding cast iron; Bhn, 160. For repairing and reclaiming of cast iron machine parts, where ductile welds that are machinable after welding are required.

Bronze electrode; a heavily coated phosphor bronze core electrode; furnished in rods; for joining brass, bronze and other copper-base alloys. Also for joining steel and cast iron to bronze and for reclaiming cast iron parts.

Aluminum electrode; of pure aluminum or aluminum plus 5% silicon alloys, flux coated. Furnished in rod form; for welding commercially pure aluminum or other aluminum-base alloys.

Silver-Green; alloy steel; furnished in rods; hardness, Rockwell C 45-59. For repair and rebuilding of cutting edges exposed to impact and wear. For example, chisels, stamping dies, perforating dies, punches, etc.

Silver-Blue; alloy steel; furnished in rods; hardness, Rockwell C, 48-54. For repair of cold working dies, broaches, gages. Weld metal is nondeforming upon heat-treatment.

Silver-Red; alloy steel; furnished in rods; hardness, Rockwell C, 62-64. For building up high speed cutting edges on tools such as planer and milling tools, high speed drills, lathe centers, etc.

AGRICOLA (Bearing bronze)—Saginaw Bearing Co., Saginaw, Mich.

Cu 70, Pb 30; impurities less than 0.2 of 1; resists corrosion caused by acids; resists heat to 500 F; ductility, medium. Especially adapted to diesel and airplane engine bearings.

AIRCO (Welding electrodes) — Air Reduction Sales Co., New York 17.

No. 78, 78E, 79E, 87, 230, 315 and 90; for welding mild steels.

No. 90A; for welding mild steel and chrome-molybdenum steels.

No. 190; for welding aircraft alloy steels to be heat treated.

No. 93, 382, 94; for welding carbon-molybdenum and low alloy, high tensile steels.

No. 312, 391; for welding mild and alloy steels.

No. 91; for welds requiring resistance to sliding abrasion and shock.

No. 100; for welding aluminum bronze, manganese bronze, cast iron.

No. 70; for welding phosphor bronze.

No. 77; for welding nonmachinable cast iron.

No. 375; for welding machinable cast iron.

AIRCO (Cast welding rods)—Air Reduction Sales Co., New York 17.

No. 1; alloy steel rods for oxyacetylene welding of steels comparable to Grade A and Grade B pipe analyses.

No. 4; high tensile steel rod.

No. 5; nickel steel rod for welding nickel, tool and other alloy steels.

No. 6; chrome vanadium steel rod for producing wear resisting surfaces.

No. 7; mild steel rod for general welding.

No. 9; cast iron rod.

No. 11; carbon molybdenum rod for oxyacetylene welding of carbon molybdenum piping for high-pressure, high-temperature service.

No. 27, 20 and 22; flux coated bronze rod for oxyacetylene brazing and welding.

No. 27; low fuming bronze rod.

No. 20; flux coated bronze rod.

No. 23A; silicon copper rod offers high tensile strength and excellent color match for copper.

No. 25; drawn aluminum rod for welding sheets of the common aluminum alloy compositions.

No. 26; drawn silicon-aluminum rod for welding and brazing silicon-aluminum alloy products.

No. 716; aluminum brazing wire.

AJAX (Hard rubber)—Vulcanized Rubber & Plastics Co., Morrisville, Bucks County, Pa.

Furnished in sheet, strip, rod and tubes. Abrasion resistance, high; max cont serv temp, 140 F; is slow burning; flexibility, high; dielectric strength (volts per mil inst.), 470; ts, 7000-9500 psi; flex str, 10,000-15,000 psi; elong, 3.5-6.0%; moisture absorption, nil; produced in black, brown and mottled; sp gr, 1.17-1.19; is opaque; machinability, excellent; hardness, Rockwell HR 90-105.

AJAX (Rubber)—Hewitt Rubber Div., Hewitt-Robins Inc., Buffalo 5.

Rubber for hose, belting and packing. Can be furnished extruded or for molding. Abrasion resistance, high. For use wherever hose, belting or packing are required.

AJAX (High-carbon tool steel)—Kidd Drawn Steel Co., West Aliquippa, Pa.

Open hearth and electric furnace tool steels; Open hearth, C 1.00-1.20, Mn 0.30-0.50, P 0.04 max, S 0.045 max, Si 0.15-0.25. Electric furnace, the same analysis with the exception of C 1.00-1.10, and Mn 0.40 max. Furnished in finished bars or rods and wire. Slow heating treatment, 1425-1550 F; drawing temperatures depending upon size of section and hardness required. Bhn (as drawn), 197-207. For drills, taps, threading dies, etc.

ALADDIN ROD (Welding and brazing rod)—Aladdin Rod & Flux Mfg. Co., Grand Rapids 7, Mich.

For welding parts made of any of the zink base metals and for brazing aluminum. Produced in rods 1/32 to ¼-in. diameter. Ts, 47,300 psi; elong in 2 in., 8.4%; bhn, 83; sp gr, 6.8; melting point, 733.6 F.

ALCLAD (Clad aluminum)—Aluminum Company of America, Pittsburgh.

14S; same as Alcoa 14S composition; sheet, plate; ts, 61-68,000 psi. For general structural applications where high resistance to corrosion and high strength are required.

24S; same as Alcoa 24S composition; sheet and plate; same strength as Alcoa 24S. For structural construction in aircraft.

75S; composition same as Alcoa 75S; sheet and plate; ts, 76,000 psi. For structural uses in aircraft; strong aluminum alloy.

3S; same as Alcoa 3S composition; tubing; ts, 15-28,000 psi. For handling liquids where corrosion is a problem.

ALCOA (Aluminum alloys)—Aluminum Company of America, Pittsburgh.

2S; commercially pure aluminum sheet and plate, rod, bar, wire, rivets, press forgings and impact extrusions. Ts, 13-24,000 psi. For sheet-metal work, chemical equipment and chemical conductors.

3S; Mn 1.2; in sheet and plate, forgings, extruded shapes, tubing rod, bar and wire; ts, 16-29,000 psi. For sheet-metal work and gasoline tanks for aircraft and chemical equipment.

4S; Mn 1.2, Mg 1.0; sheet, plate, tubing; ts, 26-40,000 psi; for high pressure gas and oil lines in automotive field.

11S; Cu 5.5, Pb 0.5, Bi 0.5; wire, rod and bar, screw machine products, ts, 55-59,000 psi.

14S; Cu 4.4., Si 0.8; Mn 0.8, Mg 0.4; heat-treatable forgings, extruded tubing and pipe, extruded and rolled shapes; ts, 62-70,000 psi. For heavy-duty forgings, power shovel bails, airplane fittings, etc.

17S; Cu 4, Mn 0.5, Mg 0.5; furnished in rod and bar, wire, rivets and screw machine products; ts, 62,000 psi. For structural applications in transportation fields.

A17S; Cu 2.5, Mg 0.3; rivets and rivet wire; ts, 43,000 psi. For aircraft; rivets can be driven in fully heat-treated condition.

18S; Cu 4, Mg 0.5, Ni 2; heat-treatable forgings; ts, 62,000 psi. Used for forged aircraft engine pistons where good strength at elevated temperatures is required.

24S; Cu 4.5, Mn 0.6, Mg 1.5; sheet and plate, rod and bar, wire, tubing, extruded shapes, rivets; ts, 68-73,000 psi. For structural construction in aircraft.

25S; Cu 4.5, Si 0.8, Mn 0.8; forgings for airplane propellers; ts, 58,000 psi.

32S; Cu 0.9, Si 12.5, Mg 1, Ni 0.9; heat-treatable forgings for pistons, low coefficient of expansion; ts, 56,000 psi.

A51S; Si 1, Mg 0.6, Cr 0.25; heat-treatable forgings for machine and automotive parts, especially for intricate forgings, ts, 48,000.

52S; Mg 2.5, Cr 0.25; furnished in sheet and plate, tubing, rod, bar and wire; marine and transportation applications; ts, 27-41,000.

53S; Si 0.7, Mg 1.3, Cr 0.25; furnished in wire, rivets and screw machine parts; ts, 30-39,000 psi. For structures subject to severely corrosive conditions in naval and industrial applications.

56S; Mg 5.2, Mn 0.1, Cr 0.1; rod, wire and rivets; ts, 42-62,000 psi. For joining magnesium and for cable sheathing.

61S; Cu 0.25, Si 0.6, Mg 1, Cr 0.25; ts, 35-45,000 psi; in sheet and plate, tubing, rolled and extruded shapes, wire, rod and bar and impact extrusions. For applications in shipbuilding and transportation fields.

63S; Mg 0.65, Si 0.4; extruded shapes, extruded tubing; ts, 22-35,000 psi; for architectural applications, particularly when a pleasing anodic coating is desired.

75S; Cu 1.6, Mn 0.2, Mg 2.5, Zn 5.6, Cr 0.3; sheet, plate, rod, bar, wire and extruded shapes; ts (sheet), 82,000 psi; extrusions, 88,000 psi. For structural applications in aircraft.

13; Si 12; ts, 39,000 psi; a general-purpose die casting alloy for large, intricate parts.

43; Si 5; ts, 19-30,000 psi; available as sand, permanent-mold, and die castings. For castings that must be leakproof under pressure such as sewage disposal plant and pipe fittings.

85; Cu 4, Si 5; ts, 40,000 psi. General-purpose die casting alloy for brackets, frames and levers with thick sections.

108; Cu 4, Si 3; furnished as sand castings for manifolds, valves and other intricate castings requiring pressure tightness; ts, 21,000 psi.

A108; Cu 4.5, Si 5.5; furnished as permanent-mold castings for general-purpose castings of intricate design; ts, 28,000 psi.

C113; Cu 7, Si 3.5; permanent-mold castings for automotive engine cylinder heads; ts, 30,000 psi.

122; Cu 10, Mg 0.2; sand and permanent-mold castings for automotive pistons, camshaft bearings, valve tappet guides; ts, 27-48,000 psi.

A132; Cu 0.8, Si 12, Mg 1, Ni 2.5; permanent-mold castings for pistons; ts, 36-47,000 psi.

D132; Si 9, Cu 3.5, Mg 0.8, Ni 0.8. Permanent-mold castings for automotive pistons; ts, 36,000 psi. General characteristics similar to A132.

138; Cu 10, Si 4, Mg 0.3, Fe 1; permanent-mold castings for flat iron sole plates; retains strength and hardness at elevated temperatures; ts, 32,000 psi.

142; Cu 4, Mg 1.5, Ni 2; sand and permanent-mold castings for pistons and aircooled cylinder heads; ts, 27-47,000 psi.

195, Cu 4.5, Si 0.8; sand castings for general structural purposes; ts, 32-40,000 psi.

B195; Cu 4.5, Si 2.5; permanent-mold castings for general structural purposes; ts, 37-45,000 psi.

212; Cu 8, Si 1.2; sand castings for general purposes; ts, 23,000 psi.

214; Mg 3.8; sand castings; ts, 25,000 psi. For marine fittings, machine parts; has high resistance to salt-water corrosion.

A214; Zn 1.8, Mg 3.8; permanent-mold castings for marine fittings and hardware; ts, 27,000 psi.

218; Mg 8; ts, 45,000 psi; furnished as die castings for marine fittings and hardware.

220; Mg 10; sand castings; ts, 46,000 psi; for aircraft fittings, railroad car parts, heavy-duty castings, power shovel dipper parts, marine applications.

355; Cu 1.3, Si 5, Mg 0.5; permanent-mold and sand castings; ts, 28-45,000 psi. For cylinder heads and crankcases for diesels and liquid-cooled aircraft engines.

356; Si 7, Mg 0.3; permanent-mold and sand castings; ts, 25-40,000 psi. For high-strength pressure-tight castings of intricate shape.

360; Si 9.5, Mg 0.5; die castings; ts, 44,000 psi; general-purpose alloy for large, intricate castings; a substitute for Alloy 13 for castings to be made in a cold chamber machine.

380; Cu 3.5, Si 8.5; ts, 45,000 psi; a high-strength general-purpose die casting alloy.

384; Si 12, Cu 3.8; ts, 46,000 psi. General-purpose die casting alloy with slightly better casting properties than 380. Fair resistance to corrosion and good machinability.

113; Cu 7, Si 2, Zn 1.7; sand and permanent-mold castings; ts, 24-28,000 psi. For crankcases, oil pans, cylinder heads, and other automotive applications.

B214; Si 1.8, Mg 3.8; sand castings, ts, 20,000 psi. For pipe fittings, etc.; has high resistance to salt water corrosion.

F214; Si 0.5, Mg 3.8; sand castings; ts, 20,000 psi. For architectural applications and hardware; provides light-colored anodic coating.

319; Cu 3.8, Si 6; sand castings; ts, 27-36,000 psi. For general purposes.

333; Cu 3.8, Si 9, Mg 0.4; permanent-mold castings; ts, 32,000 psi. For automotive pistons.

750; Cu 1, Ni 1, Sn 6.5; permanent-mold castings. Ts, 20,000 psi. For bearing inserts in high-duty internal combustion engines as connecting rod, main and thrust bearings.

ALCUPLATE (Composite aluminum-copper)—General Plate Div. of Metals and Controls Corp., Attleboro, Mass.

Aluminum on copper or copper on aluminum laminated material. Al 90, Cu 10; Al 80, Cu 20; Al 70, Cu 30; furnished in straight and coiled strips and in sheets. Hardness number, as specified. For electrical connectors, terminals, clamps, etc., wherever copper and aluminum are used.

ALDECOR (Alloy steels)—Alloys Development Co. Pittsburgh, Pa.

Steel containing molybdenum, copper, silicon and phosphorus, furnished in rough bars or billets, finished rods or bars, straight and coiled strip, sheets and plates for turning, boring, forging, stamping and welding. In untreated state: Ts, 70,000 psi min; ys, 50,000 psi min; elong in 2 in., 22 per cent min; sp gr is same as ordinary steel; weldability, good; resists corrosion caused by atmospheric exposure; abrasion resistance, medium. Used in transportation equipment to reduce dead-weight. Also produced by Republic Steel Corp.

ALLCAST No. 60 (Aluminum alloy)—Apex Smelting Co., Cleveland 5, and Chicago 12.

Nominal composition; Cu 3.5, Si 6; furnished in ingots for sand, precision and permanent-mold castings. Typical properties as-sand-cast, untreated, ts, 28,000 psi; ys, 17,000 psi; elong, 2.5; Bhn, 70. Range of typical properties under various heat treatments; ts, 37,000-47,000 psi; ys, 24,000-42,000 psi; elong, 1.0-3.0; Bhn, 85-105. Sp gr, 2.73; nonmagnetic; weldability, good; abrasion resistance, medium. A general all-purpose aluminum alloy which is used in the as-cast or heat-treated condition, to meet a variety of applications, ranging from ornamental to highly stressed castings.

ALLEGHENY GRADE 609 (Shock resisting steel) — Allegheny Ludlum Steel Corp., Brackenridge, Pa.

C 0.60, Mn .80, Si 2.00, Cr 0.25, Mo 0.25, V 0.20. A silico-manganese shock-resisting steel for heavy duty springs, collets, press clutch parts, stressed bolts and studs, die head bodies, shafts, and other machine parts subject to shock and wear. May be hardened in oil or water.

ALLEGHENY LUDLUM (Alloy Steels)—Allegheny Ludlum Steel Corp., Brackenridge, Pa.

"4750"; a high permeability nickel-iron alloy containing approximately 48 per cent nickel, balance iron, that must be hydrogen annealed after fabrication. Available in form of sheets, flats, squares, strip, etc.; also in the form of laminations and shields. Used in audio transformers, sensitive relays, and electrical instruments.

"88-x"; a nonmagnetic high-strength alloy material, not at all stainless which finds applications for mountings in power transformers, and on high-current bus boards in power generating stations and substations. Typical analysis—C .3, Mn 10, Ni 8, bal., Fe.

Electrical steels; furnished in coiled strip and sheets for manufacture of laminations. Used in construction of motors, transformers, relays, electromagnets, radios, etc. These steels contain ½-5 per cent silicon, depending on the application.

Relay steels; annealed silicon steel rounds, flats, squares, etc., containing ½-2¾ per cent silicon, which find wide application for relays, electromagnets, etc.

Laminations for transformers, motors, and miscellaneous small electrical equipment and parts. Made from all grades of silicon steel and from high permeability alloys, such as Allegheny Ludlum "4750" and Allegheny Ludlum Mumetal.

Cast resistance grids: No. 17 metal. Castings having high electrical resistance and ability to withstand continued severe mechanical shock even at high temperatures. Applications include motor starters, crane motor controls, mine locomotive controls, and power house equipment.

ALLEGHENY METALS (Stainless Steels)—Allegheny Ludlum Steel Corp., Brackenridge, Pa.

Standard stainless steels of AISI type. For type, application and characteristic data see "Stainless Steels" listing at end of this section.

ALLEGHENY METAL, STAINLESS CLAD (Stainless-clad mild steel)—Allegheny Ludlum Steel Corp., Brackenridge, Pa.

Combination of mild steel and stainless steel; in sheets, strips, and plates; for general fabrication; corrosion resistant. Combines qualities of the stainless steel and plain steel of which it is composed.

ALL-STATE (Welding and brazing rods and solders)—All-State Welding Alloys Co. Inc., White Plains, N. Y.

No. 1: Cast-iron welding rod. Properties of weld: Ts, 48,000 psi; bhn, 80-100; machinability, good; max cont serv temp, 1200 F; abrasion resistance, low. For welding cylinder blocks and heads, gear boxes, housings, etc.

No. 2: Machinable cast-iron electrode; copper-nickel. Weld properties: Ts, 30,000 psi; bhn, 80-100. For motor blocks and heads, filling blow holes in castings, building up errors in machining, etc.

No. 4: Fully machinable cast-iron electrode, approximately 100% nickel. Weld properties: Ts, 30,000 psi; bhn, 80-100; machinability, good; max cont serv temp, 2000 F; abrasion resistance, low. For welding cylinder blocks and heads, gear boxes, housings, etc.

No. 7: Cast-iron solder, tin-lead-zinc composition; furnished in rods and bars for welding cast iron. Weld properties: Ts, 1000 psi; bhn, 30. For low temperature application; for welding motor blocks and heads, and filling blow holes in castings, etc.

No. 11 and No. 13: Nickel-silver welding rods for welding all ferrous and nonferrous metals with the exception of aluminum and die cast metals. Weld properties: Ts, 100-160,000 psi; bhn, 180-220. Resists corrosion caused by all salts with the exception of ammonia. For carbide tips, extensions on drills, cutters, bits, shafting, drive splines, trolley shoes, gear teeth, gear boxes, etc.

No. 21: Phosphor-copper welding rods furnished in rods and bars. For joining all copper and copper-bearing alloys. Weld properties: Ts, 40,000 psi; ys, 35,000 psi. For use on buss bars, electric contact points, circuit breakers, refrigeration units, etc.

No. 23: Phosphor-copper-silver welding alloy, furnished in rods; for joining copper and copper-bearing alloys. Weld properties: Ts, 50,000 psi; ys, 40,000 psi; resists corrosion caused by weather and milk acids. For use on buss bars, contact points, electrical units, refrigeration units, copper coils, circuit breakers, bronze bushings, etc.

No. 31 and No. 33: Aluminum brazing alloys, furnished in rods for joining aluminum alloys. Joint properties: Ts, 30,000 psi; is as resistant to any corrosive agent as the parent metal. For joining sheet and cast aluminum, broken aluminum castings; is close color match.

No. 39: Tin-zinc solder, furnished in rods. For joining aluminum to dissimilar metals; resists corrosive action of salt water, atmosphere, etc. Used on aluminum castings, aluminum sheet and for joining aluminum to other dissimilar metals.

No. 41: Brazing rod composed of copper, tin, iron and zinc, for joining ferrous and nonferrous metals, except aluminum. Joint properties: Ts, 50,000 psi. For bronze castings, steel castings, copper, brass, bronze parts such as propeller blades and impellers; excellent color match on brass.

No. 53: Welding rod composed of lead, aluminum, copper and zinc; for joining die castings.

No. 61: Brazing rod composed of aluminum, magnesium, zinc, silicon and manganese; for joining parts made of magnesium. Has low melting point and higher strength than base metal.

No. 100: Silver solder rods of silver, copper, zinc and nickel. Also furnished in sheets, strips and powders. For joining ferrous and nonferrous metals except aluminum and die castings. Properties of joint: Ts, 56,000 psi; resists corrosion caused by atmosphere and salt water. Used in fabrication of copper and steel parts, carbide tips, steel shanks, alloy steels, stainless steels, nickel alloys, etc.

No. 101: Silver solder composed of copper, silver, zinc and cadmium. Furnished in rods, sheets, strips and powders. Used for joining nonferrous and ferrous metals, except aluminum and die castings. Joint properties: Ts, 52,000 psi; resists corrosion caused by atmosphere and salt water. Used in the production of carbide tips, small assemblies, furnace brazing, piping systems, etc.

No. 111: Silver solder composed of copper, silver, zinc and cadmium. Furnished in rods, strips, sheets and powders. For joining ferrous and nonferrous metals, except aluminum and die castings. Joint properties: Ts, 50,000 psi; resists corrosion caused by atmosphere and salt water. Is thin flowing, has high capillary action and an affinity for ferrous and nonferrous metals. Used in producing carbide tips, small assemblies, furnace brazing and piping systems, etc.

No. 120: Silver solder composed of copper, silver, zinc and cadmium. Furnished in rods, sheets, strips and powders. For joining ferrous and nonferrous metals, except aluminum and die castings. Joint properties: Ts, 75,000 psi; resists corrosion caused by atmosphere and salt water.

ALLYMER (Allyl resin monomers)—Pittsburgh Plate Glass Co., Columbia Chemical Div., Barberton, O.

A complete line of allyl resin monomers formerly known as Columbia resins and designated as C. R. 39, etc. The numbers such as 38 and 149 continue to designate types. Various compounds such as Fiberglas base and allyl resin, allyl alcohol base resin, paper-base and allyl resin, cotton-cloth and allyl resin, for both C.R. 39 and C.R. 149 types are available. Thermosetting; furnished in sheets, rods or tubes and laminated form. Properties for these materials include corrosion, heat and impact resistance, high tensile strength and low moisture absorption.

ALMET (Stainless steels) — Alloy Metal Wire Co., Inc., Prospect Park, Pa.

Standard stainless steels of AISI types. For type numbers, characteristics and properties see "Stainless Steels" listing at end of this section.

ALNICO (Permanent magnet alloys)—General Electric Co., Chemical Dept., Pittsfield, Mass.

Have high coercive force and high magnetic energy. Seven grades are available—Nos. 1, 2, 3, 4, 5, 6, and 12—each with different combinations of the basic ingredients aluminum, nickel, and cobalt and different magnetic properties. All seven grades can be cast, but only Alnico 2, 4 and 5 are commercially available in sintered form. Sintered and cast Alnico furnished by General Electric and the following licensees: Cast Alnico only furnished by the following: Belden Mfg. Co., Chicago; Taylor Wharton Iron & Steel Co., High Bridge, N. J.; and Thomas & Skinner Steel Products Co., Indianapolis. Sintered Alnico only furnished by Stackpole Carbon Co., St. Marys, Pa.

ALPRO (Nonferrous alloys)—Alloys & Products Inc., New York 59.

More than 1000 nonferrous metal alloys of various compositions in shot, slab, ingots and miscellaneous forms.

ALRAY (Electrical resistance alloys) — Alloy Metal Wire Co., Inc. Prospect Park, Pa.

A; Cr 20, Ni 80. Furnished in flat wire, rod and strip. For heating elements in electrical appliances and industrial heating equipment to meet most severe conditions of temperature and oxidation. Max cont. serv. temp. 2000 F; has good weldability.

C; Cr 15, Ni 62, balance Fe. For heating elements in electrical appliances and industrial heating equipment to meet most severe conditions of temperature and oxidation. Max. cont. serv. temp. 1700 F.

D; Cr 18, Ni 35, balance Fe. For heating elements in electrical appliances and industrial heating equipment to meet most severe conditions of temperature and oxidation. Max cont. serv. temp, 1400 F.

AlSiMag (Ceramics) — American Lava Corp., Chattanooga 5, Tenn.

Ceramic parts of various grades and compositions custom made to individual requirements.

35 and 196; steatite possessing high mechanical strength with low electrical losses at high frequency for use in most electrical and electronic applications.

243; forsterite; very low electrical losses at high frequency.

197; steatite with high dielectric and mechanical strength, low dielectric leakage at elevated temperatures.

72 and 202; cordierite; resistant to heat shock for combustion tips and thermocouple insulators.

222; refractory material which can be machined in the fired state.

192; special hard material with high polish for thread guides; resists corrosion except hydrofluoric acid.

ALUMINWELD (Welding electrode) — Lincoln Electric Co., Cleveland.

5% silicon-aluminum-alloy electrode for arc-welding aluminum in any form—cast, sheet, shapes, or extruded forms. For either metallic or carbon arc welding. Welds are very dense without porosity and possess high tensile strength.

AMBERLITE (Plastics resin adhesive)—Resinous Products & Chemical Co., Philadelphia 5.

Phenolic resin adhesive, furnished in powder form; has low moisture absorption, high density. Used in manufacture of waterproof plywood for aircraft and marine use.

AMBRAC (Copper-nickel-zinc alloy) — American Brass Co., Waterbury, Conn.

Alloy 850; Cu 75, Zn 5, Ni 20; high ductility. used for condenser tubes, etc.

AMERICAN (Bonded metals)—American Nickeloid Co., Peru, Ill.

Chromium, nickel, brass, copper, gold resemblance and colors bonded to base metals such as steel, tin-plate, zinc, brass, copper, aluminum and nickel silver. Available in brilliant finishes and patterns as sheets, flat strips, coiled strip and round edge flat wire. Can be supplied with gum-adhered paper covering protecting prefinish in drawing and preforming.

Copper steel; copper plated to steel, latter serving as rust resistant, inexpensive metal, conserving quantities of critical solid copper. Available in polished and unpolished finishes in sheets, flat strips and coiled strip for continuous feed automatic presses.

AMERICAN (Felt)—American Felt Co., Glenville, Conn.

Felt material furnished in sheet, rods or tubes; for machining, stamping and extruding into parts. Abrasion resistance for certain felts is low, while for others high; resists corrosion caused by neutral conditions; heat-resistant to 250 F; flexibility, low, medium or high (as specified); moisture absorption also as specified; produced in any color. For oil retaining, dust excluding filtering and vibration dampening.

AMERICAN Marine Genuine (Babbitt)—United American Metals Corp., Brooklyn 22, N. Y.

Furnished in bars. In cold-worked state; ts, 8750 psi; comp str, 10,140 psi; ys, 8000 psi; elong in 2 in., 1.00 per cent. For heavy-duty marine engines.

AMERICAN (Plywood) — American Plywood Corp., New London, Wis.

Phenolic urea plywood furnished in sheet and laminated form; for machining into parts. Abrasion resistance, medium; heat resistant to 300 F; flexibility, high; ts, 12,000 psi; moisture absorption, medium; inflammable; shatterproof; opaque; can be highly polished.

AMERIPOL (Synthetic rubber)—The B. F. Goodrich Co., Akron, O.

Parts to specification of oil-resisting and heat-resisting synthetic rubber; compounded and vulcanized to give wide range of properties. Ts, approx 4000 psi. In uncompounded form, has specific gravity of 1. Grease seals, packing rings, grommets and washers, etc.

AMEROID (Casein thermoplastic) — American Plastics Corp., New York 1.

Furnished in rods or sheets for machining. Abrasion resistance, medium; resistant to weak acids and organic solvents; softens when exposed to weak alkalies; decomposes when exposed to strong acids or alkalies. Max cont. serv. temp. 150 F; flexural str, 10,000-18,000 psi; dielectric str, 400-700 volts per mil; ts, 10,000 psi; comp str, 27-53,000 psi; impact str, 1.0 ft lb (Izod); produced in colors; moisture absorption, medium; sp gr 1.34; translucent and opaque; machinability, good; Bhn 23. Used for bushings, knobs, etc.

AMMONODUCT (Butt-welded steel pipe)—Bethlehem Steel Co., Bethlehem, Pa.

Cold bending, butt-welded steel pipe for refrigeration purposes.

AMPCOLOY (Copper-base alloys)—Ampco Metal Inc., Milwaukee 4.

Grade A-3; Cu 89, Al 10, Fe 1; furnished as sand or centrifugal castings, rods or bars. Corrosion-resistant. Good properties to 1000 F; ts, 70,000 psi; ys, 26,000 psi; bhn, 3000-kg. 115; fair abrasion resistance; high ductility; nonmagnetic; good bearing properties. Used for bushings, bearings, and pickling equipment. Can be forged and welded.

Grade A-323; heat-treated, to A-3 analysis above. Furnished as sand or centrifugal castings, rods and bars. Corrosion-resistant. Good physical properties to 750 F; ts, 80,000 psi; ys, 40,000 psi; bhn, 3000-kg. 145; high ductility; good abrasion resistance; nonmagnetic; excellent bearing properties. Used for bushings, bearings, gears and sleeves; also screw-down nuts; can be forged and welded.

Grade E-1; analysis similar to A-3 above; furnished as sand or centrifugal castings. Corrosion-resistant. Good physical properties to 1000 F; ts, 75,000 psi; ys, 30,000 psi; bhn, 3000-kg. 140; fair abrasion resistance; fair ductility; nonmagnetic; good bearing properties. Used for bearings, bushings, gears and pickling equipment.

Grade E-117; analysis similar to A-3 above. Heat-treated. Furnished as sand or centrifugal castings. Corrosion-resistant. Good physical properties to 750 F; ts, 90,000 psi; ys, 66,000 psi; bhn, 3000-kg. 225; good abrasion resistance; nonmagnetic. Finds use in special applications. Can be welded or forged.

Grade 46-22; Cu balance, Al 10-11, Fe 4-6, Ni 4-6; furnished as sand castings, rods or bars. As heat-treated: Ts, 110,000 psi; ys, 60,000 psi; elong 10 per cent; reduction of area, 8 per cent; bhn, 3000-kg, 217-348. For use where strength with ductility is required. Can be forged and welded.

62, 64 and 66; a series of low, medium and high strength manganese bronzes. Furnished as sand or centrifugal castings. Ts, from 65-110,000 psi; ys, 30-65,000 psi; bhn, 3000-kg, 115-215. Finds many uses for structural parts not requiring best bearing characteristics. Can be readily forged and all three grades are weldable.

86; beryllium-copper; Cu 96.3; Be 2.5; Ni 1.2; furnished as sand or centrifugal castings; heat-treated, ts, 100,000 psi; ys, 90,000 psi; bhn, 3000-kg. 400. Used for welding dies and safety tools.

91 and 97; high conductivity copper-chromium and copper-cobalt, beryllium alloys; supplied as sand or centrifugal castings; before final heat treatment can be forged; high electrical, thermal conductivity. Used as welding wheels, electrodes, collector rings, collector shoes, current-carrying parts of electrical and other machinery.

Grade 342; Cu 75, Sn 5, Pb 20. Furnished in 10-ft lengths of continuous-cast bars and tubes. Untreated, ts is 31,000 psi; ys, 18,000 psi; elong in 2 in., 14 per cent; bhn (500-kg) 57; nonmagnetic; weldability, poor; corrosion resistance, high. For soft bronze bearings, bushings, seals, seat rings, etc.

Grade 346; Cu 80, Sn 10, Pb 10. Furnished in 10-ft lengths of continuous-cast bars and tubes. Untreated, ts is 48,000 psi; ys, 25,000 psi; elong in 2 in., 15 per cent; bhn (500-kg) 78; nonmagnetic; for general-purpose bronze bearings, bushings, seals, seat rings, etc.

Grade 351; Cu 75, Sn 10, Pb 15. Furnished in 10-ft lengths of continuous-cast bars and tubes. Untreated, ts is 40,000 psi; ys, 22,000 psi; elong in 2 in., 13 per cent; bhn (500-kg) 72; nonmagnetic; corrosion resistant to weak acids such as mine waters. For bearings, bushings, pump seals, valve seats, etc.

Asarcon 773; Cu 83, Sn 7, Pb 7, Zn 3. Furnished in 10-ft lengths continuous-cast to 4½-in. diam rod and tube. Untreated, ts is 44,000 psi; elong in 2 in., 24%; bhn (500 kg), 76; nonmagnetic. For general-purpose bearings, bushings and seals.

Grade 384; Cu 85, Sn 5, Pb 9, Zn 1. Furnished in 10-ft lengths of continuous-cast bars and tubes. Untreated, ts is 42,000 psi; ys, 21,000 psi, elong in 2 in., 20 per cent; bhn (500-kg) 67; nonmagnetic; for general-purpose bearings, bushings, seals, etc.

Grade 583; Cu 84, Sn 10, Pb 2.5, Ni 3.5. Furnished in 10-ft lengths of continuous-cast bars and tubes. Untreated, ts is 50,000 psi; ys, 30,000 psi; elong in 2 in., 20 per cent; bhn (500-kg) 67; nonmagnetic. For high-strength bearings, bushings, etc.

Grade 742; Cu 88, Sn 10, Zn 2. Furnished in 10-ft lengths of continuous-cast bars and tubes. Untreated, ts is 52,000 psi; ys,

27,000 psi; elong in 2 in., 22 per cent; bhn (500-kg) 85; nonmagnetic. For hard bronze gears, bearings, bushings, valve stems, shafting, seat rings, etc.

Grade 782; Cu 85, Sn 5, Pb 5, Zn 5. Furnished in 10-ft lengths of continuous-cast bars and tubes. Untreated, ts is 43,000 psi; ys, 22,000 psi; elong in 2 in., 25 per cent; bhn (500-kg) 67; nonmagnetic. For bearings, bushings, pump seals, valve seats, etc.

Grade 40; Al 9.5-10.5, Fe 0.20 max, Cu balance. Furnished in rough bars or billets and finished rods and bars. Untreated, ts is 70,000 psi; ys, 25,000 psi; elong in 2 in., 20 per cent; bhn (3000-kg), 130; nonmagnetic; resists sulphuric acid. For pump valves in acid service, etc.

Grade 44; Al 11-12, Fe 0.20 max, others 0.25 max, Cu balance. Furnished in centrifugal castings, rough bars or billets and wire. Untreated, ts is 70,000 psi; ys, 35,000 psi; elong in 2 in., 2 per cent; bhn (3000-kg), 185. For welding dies, electrode holders, flash and butt welding jaws, etc.

Grade 45-22; Al 9.7-10.9. Fe 2.0-3.5, Ni 4.5-5.5, Mn 1.5 max, others 0.5. Cu balance. Furnished as castings, rough bars or billets, and finished rods and bars. Heat treated, ts is 105,000 psi; ys, 55,000 psi; elong in 2 in., 10 per cent; bhn (3000-kg) 200; non-magnetic; weldability, good; resists weak acids. For gears, bearings, shafts, etc.

Grade 49; aluminum bronze; furnished in finished rods or bars and tubing. No heat treatment required. Ts, 75-90,000 psi; ys, 37-45,000 psi; elong in 2-in., 15-30%; bhn, 150-175. Nonmagnetic; machinability, good; weldability, good; resistant to many types of corrosion; max cont serv temp, 1000 F; abrasion resistance, high. Excellent cold heading bar and wire material for spring, bolts, nuts, rivets; also used for heat exchanger tubes.

Grade 50; Cu 83-85; Sn 9.5-10.5, Pb 2-3, Ni 3-4, others 0.25 max. Furnished in form of rough bars or billets. Untreated, ts is 40,000 psi; ys, 22,000 psi; elong in 2 in., 15 per cent; bhn (500-kg), 80; nonmagnetic; weldability, poor, abrasion resistance, medium. For worm gears where speeds are high with light to moderate loads.

Grade 71; Cu 86-90; Sn 5.5-6.5; Pb 1-2; Zn 3-5, P 0.05 max, Fe 0.25 max, Ni 1.0 max, others 0.2 max. Furnished in form of rough bars or billets. Untreated, ts is 34,000 psi; ys, 16,000 psi; elong in 2 in., 22 per cent; bhn (500-kg), 60; nonmagnetic. For pressure castings, gears, bushings, bearings, etc.

Grade 72; Cu 86-89, Sn 7.5-9.0, Pb 0.3 max, Zn 3-5, P 0.05 max, Ni 1.0 max, others 0.2 max. Furnished in form of rough bars or billets. Untreated, ts is 40,000 psi; ys, 20,000 psi; elong in 2 in., 20 per cent; bhn (500-kg), 60; nonmagnetic; weldability, fair. For bushings, bearings, etc.

Grade 74; Cu 84-86, Sn 4-6, Pb 4-6, Zn 4-6, P 0.05 max, Fe 0.3 max, Ni 1.0 max, others 0.2 max. Furnished in rough bars or billets and sand and permanent-mold castings. Untreated, ts is 30,000 psi; ys, 18,000 psi; elong in 2 in., 20 per cent; bhn (500-kg), 55; nonmagnetic; weldability, fair. For valves, pipe elbows, etc., for applications up to 350 lb.

Grade 79; Cu 86-89, Sn 9-11, Pb 0.3 max, Zn 1-3, P 0.05 max, Fe 0.15 max, others, 0.2 max. Furnished in rough bars or billets. Untreated, ts is 40,000 psi; ys, 20,000 psi; elong in 2 in., 16 per cent; hardness, 70 rockwell F; nonmagnetic; weldability, fair; abrasion resistance, medium. For bushings, bearings, gears, etc.

AMPCO METAL (Copper-base alloys)—Ampco Metal Inc., Milwaukee 4.

Grade 8; aluminum bronze; furnished in straight and coiled strip, sheet and plate. No heat treatment required. Ts, 90-100,-000 psi; ys, 50-60,000 psi; elong in 2 in. 25-30%; bhn, 180-210; machinability, good; weldability, good; excellent corrosion and scaling resistance; max cont serv temp, 1000 F; abrasion resistance, high. Used for gib liners, wear strip and corrosion and wear resistant fabrications.

Grade 12; Cu balance, Al 8.5-9.3, Fe 2.50-3.25, others 0.50 max; furnished as sand or centrifugal castings; rods or bars. Corrosion-resistant. Good physical properties to 1000 F; ts, 70,000 psi; ys, 28,000 psi; comp str, 120,000 psi; sp gr, 7.73; bhn, 3000-kg., 115; elong, 25% min; abrasion-resistant; nonmagnetic. Good machinability, can be forged and welded.

Grade 15; Cu balance, Al 9-10, Fe 2.75-4.0, others 0.50 max; furnished as solid or hollow rods and bars or sheet. Corrosion-resistant. Good physical properties to 1000 F; ts, 35,000 psi; ys, 40,000 psi; sp gr, 7.62; bhn, 3000-kg, 160; elong, 25%; abrasion-resistant; nonmagnetic; has good surface finish; good bearing qualities. Used for bushings, bearings, small worm wheels, bolts, nuts or studs.

Grade 18-13; Al 10.30-11.0, Fe 3-4.24, other 0.50 max, balance Cu. Furnished in form of rough bars or billets, finished rods and bars, and sand and permanent-mold castings. Heat treated, ts is 80,000 psi; ys, 32,-000 psi; elong in 2 in., 16 per cent; bhn (3000-kg), 150; nonmagnetic; max cont serv temp, 400 F. Uses similar to Grade 18.

Grade 18-22; Al 10.30-11.20, Fe 3.0-4.25, others 0.50 max, balance Cu. Furnished as rough bars or billets, finished rods and bars, and permanent-mold and sand castings. Heat treated, ts is 95,000 psi; ys, 50,000 psi; elong in 2 in., 4%; bhn (3000-kg), 212; nonmagnetic; weldability, good; abrasion resistance, high; max cont serv temp, 400 F. For bearings, guides, wear strips, etc.

Grade 16; Cu balance, Al 9.80-10.30, Fe 3-4, others 0.50 max; furnished as sand or centrifugal castings. Corrosion resistant. Good physical properties to 1000 F; ts, 85,000 psi; ys, 32,000 psi; comp str, 125,-000 psi; sp gr, 7.62, bhn, 3000-kg, 140; elong, 20%; abrasion-resistant; nonmagnetic. Used for bushings, bearings, gear slides and shifter forks. Good machinability; can be forged and welded.

Grade 18; Cu, balance, Al 10.30-11.0, Fe 3.0-4.25, others 0.5 max; furnished as sand or centrifugal castings; also as rods or bars. Corrosion-resistant. Good physical properties to 1000 F; ts, 85,000 psi; ys, 35,000 psi; comp str, 136,000 psi; sp gr, 7.58; bhn, 3000-kg, 170; elong 16%; abrasion-resistant; nonmagnetic. Used for heavy-duty bushings, bearings, gears, worm wheels, feed nuts and pickling equipment. Fair machinability.

Grade 18-23; heat-treated version of Grade 18 above. Furnished as sand or centrifugal castings, rods or bars. Corrosion resistant. Good physical properties to 750 F; ts, 100,-000 psi; ys, 45,000 psi; comp str, 15,000 psi, sp gr, 7.60; bhn, 3000-kg, 190; elong 14%; abrasion-resistant; nonmagnetic. Used where high strength, good bearing properties and wear resistance is required. Ideal for heavy-duty worm gears.

Grade 20; Cu, balance, Al 11.40-12.20, Fe 3.25-4.50, others 0.5 max; furnished as sand or centrifugal castings, rods or bars. Corrosion-resistant. Good physical properties to 1000 F; ts, 85,000 psi; ys, 38,000 psi; comp str, 146,000 psi; sp gr 7.43; bhn, 3000-kg, 230; high abrasion resistance; nonmagnetic. Used for cams, cam rollers, welding jaws, bushings and bearings (wherever high resistance is required).

Grade 21; Cu, balance, Al 12.60-13.40, Fe 3.5-5.0, others 0.50 max; furnished as sand or centrifugal castings, rods or bars. Corrosion-resistant. Good physical properties to 1000 F; ts, 75,000 psi; ys, 45,000 psi; comp str 160,000 psi; sp gr 7.14; bhn, 3000 kg, 300; high abrasion resistance; nonmagnetic. Used in drawing and forming dies, bushings and liners, replacing steel.

Grade 22; Cu, balance, Al 13.7-14.4, Fe 4.0-5.25, others 0.50 max; furnished as sand or centrifugal castings, rods or bars. Corrosion-resistant. Good physical properties to 1000 F; ts, 80,000 psi; ys, 60,000 psi; comp str, 171,000 psi; sp gr, 7.21; bhn, 3000-kg, 330; high abrasion resistance; nonmagnetic. Used as cam rollers, wear strips, forming and drawing dies. Can be forged and welded .

Grade 24; a special high iron aluminum bronze furnished in sand and centrifugal castings. Produced especially for long run service as a drawing and forming die material. Highly wear resistant; will not scratch or gall. For drawing dies, forming rolls, extrusion punches, spinning tools, etc.

AMPCO-TRODE (Coated aluminum-bronze welding rod)—Ampco Metal Inc., Milwaukee 4.

Used for weldrod overlays on steel, cast iron, brass or bronze; repairing with high-strength bronze rod of practically all metals.

AMSCO (Steel castings and welding rods)—American Manganese Steel Division of American Brake Shoe Co., Chicago Heights, Ill.

Manganese steel castings; C 1-1.40, Mn 10-14, Si 0.25-1.00, P 0.10 max, balance Fe. Ts (heat treated), 100-135,000 psi; ys, 30-55,000 psi; elong in 2 in., 30-55 per cent; bhn, 200; magnetic permeability, 1.003-1.10; weldability, good; max cont serv temp, 500 F; abrasion resistance, medium. For dippers, gears, drilling rig parts, chains, crusher parts, bucket lips, spindles, guides, conveyor parts, dredge buckets, track-work, etc.

Chromium-Molybdenum Steel; sand castings to specification. For liners and grates for ball mills.

ANACONDA (Copper-base alloys) — American Brass Co., Waterbury, Conn.

"85" Red Brass; Cu 85, Zn 15; pipe, tube and sheet forms; particularly resistant to salt water corrosion.

Super-Nickel; Cu 69.6, Ni 30, seamless tubes, sheets and plates. For severe condenser tube service and where resistance to salt water corrosion is desired.

Free cutting phosphor bronze: Cu 88, Sn 4, Zn 4, Pb 4; corrosion, heat and abrasion-resistant; combines general characteristics of standard phosphor bronze alloys with free-cutting qualities of yellow brass.

ANCHOR CARBON-VANADIUM (Drill rod)—Anchor Drawn Steel Co., Latrobe, Pa.

Drill rods for use where toughness is required, and where minimum machining is necessary. Hardens with fine-grained tough case, and resists breakage. For pins, bushings, punches, dies, etc.

ANFRILOY (Bearing bronze)—Wellman Bronze & Aluminum Co., Cleveland.

A copper-lead-tin bearing bronze for high-speed, light-duty bearings and for bushings where pressure and thrust are not excessive.

APEX (Nonferrous die casting alloys)—Apex Smelting Co., Chicago 12.

Aluminum, zinc and magnesium-base die casting alloys in slab, ingot, shot, and piglet form.

APOLLO (Prefinished cold-rolled steel)—Apollo Metal Works, Chicago 38.

Chromsteel; cold-rolled strip, nickel-chrome-plated steel, furnished in sheets and strips, for stamping into parts. Resists heat to 800 F; abrasion resistance, medium; weldability, fair. Used generally as substitute for brass and copper sheet and other critical metals when resistance to corrosion is essential or reflectivity is needed.

APW (Silver brazing alloys) — The American Platinum Works, Newark, N. J.

Various silver brazing alloys with melting points from 1134 F. For low-temperature bonding of ferrous and nonferrous metals. Furnished in form of wire, strip, rings and filings. Also APW fluxes for use with silver brazing alloys.

APW fine, sterling and coin silver sheet, wire, rods, blanks, circles, seamless tubing, fine silver anodes, gauze, foil and special apparatus.

APW platinum metals and alloys, plate, foil, wire tubing and special apparatus.

AQUAFLEX (Plastic tubing) — Irvington Varnish & Insulator Co., Irvington, N. J.

Heavy-walled plastic tubing for conveying water and other liquids as well as for use as air hose. Can be supplied with proper metal fittings.

ARCALOY (Welding electrodes)—Alloy Rods Co., York, Pa.

Electrodes for welding stainless steels.

ARCOS (Stainless steel arc welding electrodes)—Arco Corp., Philadelphia 43, Pa.

Stainless steel and alloy arc-welding electrodes for welding all types of metals.

ARISTOLOY (Semifinished carbon steels) — Copperweld Steel Co., Warren, O.

Electric furnace semifinished carbon steels in the following forms: Ingots, strip, slabs, sheet, bars, blooms and billets, tube rounds. Conversion rolling available.

ARMACAST (Alloy steel castings)—Union Steel Castings Div., Blaw-Knox Co., Pittsburgh 1.

C 0.30, Mn 0.60-0.90, Si 0.35, Cr 2.65-3.15, Mo 0.50, P 0.05 max, and S 0.05 max. Furnished in sand castings to specification. Water-quenched and drawn: Ts, 110,000 psi min.; ys, 75,000 psi min.; elong in 2 in., 25%; impact str (Charpy), 50 ft-lb min. at room temp; bhn, 240-260; is magnetic; machinability, good; weldability, good; abrasion resistance, high. Used in applications where extraordinary strength, toughness or hardness is required. Heat treated to meet various physical requirements.

ARMCO (Steels)—Armco Steel Corp., Middletown, O.

Stainless steels in standard forms to AISI Specs. For data on types, properties and characteristics see "Stainless Steels" listing at end of this section.

Tran-Cor 72; a medium silicon steel for large generators and transformers.

Tran-Cor X, XX and XXX; Oriented electrical steel supplied in straight and coiled strip and in sheet for core laminations of distributing and power transformers.

Magnetic ingot iron; an open-hearth iron furnished in rough bars and billets, finished rods and bars, straight and coiled strip, sheet and plate. Annealed, ts is 45,000 psi; ys, 30,000 psi; elong in 2 in., 35 per cent; hardness, 40-45 rockwell B; magnetic; weldability, good. Primarily for cores of dc electrical equipment.

Galvanized Ingot Iron; an open-hearth iron furnished in straight and coiled strip and sheet. Annealed, ts is 45,000 psi; ys, 30,000 psi; elong in 2 in., 35 per cent; magnetic; for general sheet metal applications. Also supplied in Ingot Iron galvanized Paintgrip, with mill-bonderized surface to take and hold paint. Galvanized Steel; various medium and low-carbon analyses, copper-bearing steel in coiled and straight strip and sheet; magnetic; weldability, fair. For general sheet metal applications. Also supplied in steel galvanized Paintgrip, with mill-bonderized surface to take and hold paint.

Enameling Iron: an open-hearth iron furnished in straight and coiled strip and sheet; annealed, ts is 45,000 psi; ys, 30,000 psi; elong in 2 in., 35 per cent; hardness, 45 rockwell B; magnetic; weldability, good. For sheet metal parts to be porcelain enameled.

Intermediate Transformer; scale-free medium silicon steel sheet and strip for some transformer and special applications.

Special Electric; Scale-free medium silicon steel sheet and strip. For ac motors and generators, radio power pack transformers, etc.

Electric; low-silicon electrical steel furnished in sheet and strip. For laminations in electric motors and generators.

Radio No. 6; for applications in which superior low induction magnetic characteristics are important. No. 5; for audio transformer cores and other low induction applications.

Ingot Iron; highly refined iron for magnetic cores; supplied in round and flat bar form.

Armco Ingot Iron; highly refined iron supplied in galvanized sheet for general sheet metal work; also hot-rolled annealed and cold-rolled sheets, plates and strip.

Aluminized; a special aluminum-coated sheet (strip or coil) with exceptional resistance to heat and corrosion, and good heat reflectivity.

17-14, Cu-Mo; stainless steel furnished in bars, sheets, strip, wire, and plate. Has exceptional stress-rupture and creep properties at elevated temperatures up to 1500 F. Also has outstanding corrosion resistance to certain acid environments, particularly sulfuric. For parts requiring high strength at high temperatures, or exceptional resistance to sulfuric acid.

ARMORPLY (Plywood)—United States Plywood Corp., New York.

Metal covered; furnished in sheet form; has high strength and low weight. For use in food machinery, laboratories, etc.

ARMSTRONG'S (Compositions of cork, rubber, fiber, and paper)—Armstrong Cork Co., Lancaster, Pa.

Compositions of cork and Neoprene, Buna N, Buna S, Thiokol, and butyl rubber. More than two dozen materials having a wide range of physical properties furnished in roll, sheet, cut gasket, molded, and extruded forms. Impervious to liquids and gases; highly resistant to deterioration by oils, solvents and most other liquids, gases, corona and weather; high and low coefficients of friction, high and low degrees of compressibility, lateral flow, etc.; available with or without fabric backing, with or without adhesive coating. Furnished to meet specific requirements. Used as gaskets, packings, washers, valve disks, feed rolls, polishing wheels, diaphragms, friction and vibration pads, etc.

Compositions of cork and natural rubber, for specific applications not requiring the special characteristics of synthetic rubber.

Synthetic rubber compounds for applications where requirements include properties such as resistance to oil, aromatic fuel, solvents, sunlight or electrical corona—and where lateral flow is necessary or not objectionable.

Straight cork compositions, ranging in density from 8 lb to 36 lb per cu ft, in compressibility from 5 to 60 per cent.

Fiber sheet packings including noncorrosive materials, for general gasketing.

Rag felt papers for vibration damping, space packing, anti-squeak lining and use as gaskets, dust seals, etc.

ASARCOLOY No. 7 (Cadmium-nickel bearing alloy)—American Smelting & Refining Co., New York.

Is capable of withstanding high compression loads and high operating temperatures. Ni 1.3, balance Cd. Furnished in ingots for spinning and permanent-mold castings. Resists heat to 300 F; high abrasion resistance; ts, 15,000 psi; comp str, 20,000 psi; sp gr, 8.7; bearing properties, good; weldability, good. Used for bearings.

ATHENIA (High carbon steel)—The Athenia Steel Co., Div. of National Standard Co., Clifton, N. J.

Cold-rolled, high-carbon flat steels in widths of 1/16-in. to 6½ in.; thickness, 0.0015 to 0.062-in. Custom-made steels of 0.60 carbon and higher. Entire range of annealed, hard-rolled, black-tempered, tempered and polished or tempered and polished with blue or straw-colored finish.

ATLAS No. 93 (Oil-hardening steel)—Allegheny Ludlum Steel Corp., Brackenridge, Pa.

C 0.55, Cr 0.65, Mo 0.35. For collets, studs and parts requiring toughness in hardened condition. Oil hardening. For use as bucket teeth, keys, pins, bolts, studs, etc.

AUR-O-MET (Aluminum bronzes)—Aurora Metal Co., Aurora, Ill.

Alloy No. 11B: Cu 88.5, Al 10.5, Fe 1. Supplied in the form of die castings to specification. Ts, 85,000 psi; ys, 40,000 psi; elong in 2 in., 20%; hardness, Rockwell 81B; sp gr, 7.4; machinability, fair; weldability, fair; resists corrosion caused by weak acids, brines and organic solvents; max cont serv temp, 650 F; abrasion resistance, medium. Used for gears, pumps, gibs, brackets, nuts, bearings and structural parts.

Alloy No. 11: Cu 89, Al 9.8, Fe 1. Supplied in the form of die castings to specification. Ts, 75,000 psi; ys, 30,000 psi; elong in 2 in., 30%; hardness, Rockwell B, 68-70; sp gr, 7.4; nonmagnetic; machinability, fair; weldability, fair; resists corrosion caused by weak acids, brines and organic solvents. Max cont serv temp, 650 F; abrasion resistance, medium. Used for gears, pumps, gibs, brackets, nuts, bearings and structural parts.

Alloy No. 56: Cu 80.5, Al 10.5, Fe 4.25, Ni 4.75. Furnished in the form of vacuum die castings, to specification. Ts, 95,000 psi; ys, 65,000 psi; elong in 2 in., 5-10%; hardness, Rockwell 90B; sp gr, 7.4; machinability, fair; weldability, fair; resists corrosion caused by weak acids, brines and organic solvents; max cont serv temp, 650F; abrasion resistance, medium. Used for gears, pumps, gibs, brackets, nuts, bearings and structural parts.

Alloy No. 57: Cu 76, Al 12, Fe 5 and Ni 7. Furnished in the from of vacuum die castings, to specification. Ts, 115,000 psi; ys, 85,000 psi; elong in 2 in., 0-5%; hardness, Rockwell 30 C; sp gr, 7.4; machinability, fair; weldability, fair; resists corrosion caused by weak acids, brines and organic solvents; max cont serv temp, 650 F; abrasion resistance, medium. Used for pumps, wear plates, etc.

AVIALITE (Copper-aluminum alloy)—American Brass Co., Waterbury, Conn.

Used for valve seats and guides in airplane motors.

"AW" (Rolled-steel floor plate)—Alan Wood Steel Co., Conshohocken, Pa.

Furnished in four patterns to meet flooring problems in the industrial and transportation fields; designed to withstand heaviest traffic; oilproof, crackproof, heatproof, slipproof, and noiseless. Furnished in carbon, copper or alloy analyses; also available in other nonferrous metals.

"AW" DYNALLOY (Alloy steel)—Alan Wood Steel Co., Conshohocken, Pa.

Alloy steel furnished in rough bars, sheets and plates for welding, cold forming, hot forming, stamping, etc. Abrasion resistance high; ts, 65-80,000 psi; ys, 50,000 psi; elong in 2 in., 25%; endurance limit (completely reversed bending), 45,000 psi; weldability, good. For welded structures requiring high strength, such as machine bases and tanks.

AZTEC (Asbestos packing)—Gatke Corp., Chicago 1.

Packing for high-pressure valve stems, rods and other machine elements; furnished in compressed sheet, oilproof plastics, twisted and braided stock and wire-interwoven sheet.

B

B-50 (Powder metal)—Powdered Metal Products Corp. of America, Franklin Park, Ill.

High copper content; furnished in pressed and sintered parts to specification; imp str (Izod) 2 ft-lb; Rockwell hardness, H 60; abrasion resistance, medium; for bushings, bearings, etc.

BAKELITE (Plastics) — Bakelite Corp., New York 17.

Phenolic plastics, general purpose; thermosetting; furnished in granular form for plastic molding; corrosion-resistant, dielectric strength at 60 cycles, 270-350 volts per mil.; nonflammable; ts, 6000-11,000 psi; low thermal conductivity; available in dark colors; takes high polish; low moisture absorption.

Phenolic plastics, mineral filled. Similar to above. Has high heat resistance, low moisture absorption; and is nonflammable.

Phenolic plastics, fabric-filled. Similar to general purpose phenolic plastics but are much higher in impact resistance; abrasion-resistant; impact strength (Izod) .23-2.7 ft-lb energy to break. Used for gears, bushings, bearings and heavy-duty parts.

Polyethylene; thermoplastic; has good resistance to softening by higher temperatures than any other similar material previously produced. Its outstanding characteristic is its unusually good electrical properties. It has extremely low coefficient of moisture absorption and water vapor transmission; resists the effects of practically all chemicals; is inherently flexible; can be produced as molded or extruded goods, sheet materials, film, sheeting, or any of the other usual forms of plastic materials.

Polystyrene plastics; thermoplastic; furnished in powder form for molding; transparent, translucent and opaque effects, in all colors; takes high polish; nonflammable; low moisture absorption; sp gr. 1.05-1.07; dielectric

strength at 60 cycles, 500-525 volts per mil; volume resistivity, 10 deg megohm centimeters; power factor .0002-.0003 from 60 cycles to 50,000,000 cycles; offers exceptional resistance to acids and alkalis.

Cast resins; produced as BT 44, 45, 48, 55 and 58 types; in rods, sheets, tubes and many special types of castings. BT 44, 45 and 55 are opaque, translucent and mottled; corrosion resistant; of high dielectric strength; low moisture absorption; available in colors. Used for radio cabinets, etc. BT 48 and 58 are crystal clear, transparent colors of any hue; and mottled transparents. Available as castings including rods, sheets and tubes; highly resistant to acids. Used in place of glass and can be readily machined and used for gages, peep holes, etc.

BT 61-893; available in plates only; transparent water white; very stable; color-fast; excellent in dimensional stability. Used for photoelastic stress study work.

BT 41-001; available in transparent amber castings and sheets made to order; resistant to hydrofluoric acid. Used where very high dielectric strength and low moisture absorption properties are required.

BT-48-306; nonstatic, used for instrument windows and recommended under Navy specifications. This material has high light transmission qualities.

BAKER (Precious metals)—Baker & Co. Inc., Newark 5, N. J.

Platinum and alloys for linings, contacts, thermocouples, furnace resistors, etc.

BAKER CASTING RESIN (Plastic resin)—Baker Oil Tools, Inc., Los Angeles 54.

Phenol formaldehyde thermosetting resin supplied in liquid form for casting and laminating. Abrasion resistance, low; ts, 3-5000 psi; comp str, 8-12,000 psi; impact str (Izod), 1-3 ft-lb; produced in natural and color concentrates; moisture absorption, medium; sp gr, 1.2; produced transparent, translucent and opaque.

BEARITE (Babbitt metal)—A. W. Cadman Mfg. Co., Pittsburgh.

Babbitt metal furnished in ingots and 50-lb pigs; Bhn at 70 F, 29.1; at 212 F, 24.4; comp str, 15,000 psi. For rotary bearings subjected to heavy loads and extreme speed.

BEARIUM METALS (High-lead bronzes)—Bearium Metals Corp., Rochester, N. Y.

High lead bronzes with specially prepared metallurgical structure providing good frictional properties.

Grade B-4; Cu 70, Sn 4, Pb 26. Furnished as rough cored or solid bars, as sand castings, machined bushings, and in long lengths for screw machine use. Ts, 21,000 psi; comp str, 9750 psi; Bhn, 40. Abrasion resistance, high; low coefficient of friction; high ductility. Resists corrosion caused by acids. Used for bushings, bearings, packing, piston rings, and seals.

Grade B-8; Cu 70, Sn 8, Pb 22. Furnished in rough cored or solid bars, rough castings, machined bushings, screw-machine rod stock. Ts, 25,000 psi; comp str, 11,500 psi; Bhn, 50. Abrasion resistance, high; low coefficient of friction; high ductility. Resists corrosion caused by acids. Good bearing properties. Used for bearings, bushings, packing and piston rings, seals, cross-head shoes, etc.

BEETLE (Urea-formaldehyde plastics)—Plastics Division, American Cyanamid Co., New York 20.

Thermosetting; furnished in powder or granules for molding purposes. Available in colors, translucent and opaque. Dielectric str, 300-350 volts per mil; ts, 5000-7000 psi; comp str, 30-38,000 psi; flexural str, 11-18,000 psi; shatterproof; moisture absorption, low; bhn 78.9; nonflammable. Used for housings, cabinets, knobs, dials and insulators.

BELECTRIC (Special cast iron)—Belle City Malleable Iron Co., Racine, Wis.

Furnished as sand castings. Ts, 35-60,000 psi; high compressive strength; good bearing properties; recommended heat treatments are the same as for standard gray iron; Bhn, untreated, 179-285; heat treated, 300-550. Used where rigidity, wearability, or where strong high grade gray iron might be applied.

BELECTROMAL (High-strength malleable iron)—Belle City Malleable Iron Co., Racine, Wis.

High-strength malleable iron furnished as sand castings. Ts, 60-70,000 psi; high ductility; Bhn, untreated, 140-170. Recommended for castings for automotive, railroad, tractor and implement work.

BELMALLOY (Pearlitic malleable iron)—Belle City Malleable Iron Co., Racine, Wis.

Pearlitic malleable iron, electric furnace melted and continuous-oven annealed. Ts, 70,000 psi min; ys, 45,000 psi min; elong, 5% min; Bhn, 179-217. Used for castings of machining quality requiring strength and shock resistance.

BENDIX (Flexible metal hose)—Metal Hose Dept., Bendix Aviation Corp., Teterboro, N. J.

Corrugated seamless tubing of various alloys. Used for exhausts, oil lines, vibration eliminators, etc.

BENELEX "70" (Wood-fiber panels)—Masonite Corp., Chicago.

Furnished ¼-2 in. thick; max cont serv temp, 150 F; dielectric str (volts per mil inst), 190; ts, 7700 psi; comp str, 26,500 psi; available in the color brown; is shatterproof; sp gr, 1.41; is opaque; machinability, good; hardness, Rockwell M, 90. For dies, fixtures and electrical equipment.

BERALOY "A" (Beryllium-copper alloy)—Wilbur B. Driver Co., Newark, N. J.

Beryllium-copper alloy; Cu 97.75, Be 2, and Co 0.25; furnished in soft annealed state or in slightly cold-worked conditions for easy machining and forming into parts. Ts, 66,000 psi in annealed state, can be increased to 175,000 psi by simple hardening treatment at 600 F; and by cold work after solution anneal, ts can be increased to 200,000 psi. Used for electrical spring parts, contacts, switch jaws, diaphragms, switch parts, bearings, connectors, valves, cams, etc.

BERYLCO (Beryllium copper)—The Beryllium Corp., Reading, Pa.

Beryco 10: Be 0.4, Co 2.5, balance Cu. Furnished in rough bars or billets, finished rods or bars, straight and coiled strip. In heat-treated state, ts, 130,000 psi; comp str, 140,000 psi; ys, 90,000 psi; elong in 2 in., 8-12%; impact str (Izod), 3-5 ft-lb; endurance limit, 35,000 psi; hardness, Rockwell B90-100; sp gr, 8.7; nonmagnetic; machinability, fair; weldability, fair; resists corrosion caused by atmosphere, fresh and salt water, certain alkaline and acid solutions; max cont serv temp, 400 F; abrasion resistance, high. Has high electrical and thermal conductivity; is used for springs and current carrying members.

Beryco 10C: Be 0.6, Co 2.5, balance Cu. Furnished in pig or ingot, sand castings, permanent-mold castings, and precision castings. In heat-treated state, ts, 100,000 psi; ys, 80,000 psi; elong in 2 in., 8-12%; impact str (Izod), 10-15 ft-lb; hardness, Rockwell B90-95; sp gr, 8.7; nonmagnetic; machinability, fair; weldability, fair; resists corrosion caused by atmosphere, fresh and salt water, certain alkaline and acid solutions; max cont serv temp, 400 F; abrasion resistance, high. Has high electrical and thermal conductivity; is used for circuit breaker and switchgear parts and similar electrical applications.

Beryco 20C: Be 2.0, Co 0.5, balance Cu. Furnished in pig or ingot, sand castings, permanent mold castings and precision castings. In heat-treated state, ts, 160,000 psi; ys, 135,000 psi; elong in 2 in., 2-5%; impact str (Izod), 5-8 ft-lb; hardness, Rockwell C37-43; sp gr, 8.25; nonmagnetic; machinability when heat treated is poor, when untreated, fair; weldability in untreated state, fair. Resists corrosion caused by atmosphere, fresh and salt water, certain alkaline and acid solutions; max cont serv temp, 300 F; abrasion resistance, high. Has high electrical and thermal conductivity; is used for plastic molds, safety tools, circuit breaker parts and other current carrying parts.

Beryco 25S: Be 2, Co 0.3, balance Cu. Furnished in rough bars or billets, finished rods or bars, straight and coiled strip, tubing, wire, and powder metals. In heat-treated state, ts, 200,000 psi; comp str, 205,000 psi; ys, 95,000 psi; elong in 2 in., 2-5%; impact str (Izod), 2-4 ft-lb; endurance limit, 40-50,000 psi; hardness, Rockwell C39-45; sp gr, 8.23; nonmagnetic; machinability when heat treated is poor; untreated, fair; weldability when untreated is fair; corrosion resistance, good to atmosphere, fresh and salt water, to certain alkaline and acid solutions; max cont serv temp, 300 F; abrasion resistance, high; has high electrical and thermal conductivity, high resistance to drift and hysteresis. For springs and current-carrying members, contacts, bushings, diaphragms and other pressure responsive elements.

Beryco 275C: Be 2.7, Co 0.5, balance Cu. Furnished in pig or ingot, sand castings, permanent-mold castings, and precision castings. In heat-treated state, ts, 175,000 psi; ys, 145,000 psi; elong in 2 in., 2-5%; impact str (Izod), 3-6 ft-lb; hardness, Rockwell C41-45; sp gr, 8.1; nonmagnetic; machinability when heat treated is poor; when untreated, fair; weldability when untreated is fair; resists corrosion caused by atmosphere, fresh and salt water, certain alkaline and acid solutions; max cont serv temp, 300 F; abrasion resistance, high; has high electrical and thermal conductivity; used for plastic molds, small cast precision parts, current-carrying members, etc.

BESCOLOY (Alloy steel castings)—Brighton Electric Steel Casting Co., Beaver Falls, Pa.

Alloy steel; Ni 3, Cr 2, and Mo 7, Cr 2. Furnished in sand castings to specification. Ts, 115,000 psi; ys, 65,000 psi; elong in 2 in., 20; bhn (heat treated), 321. Machinability, fair; weldability, good; abrasion resistance, high.

BETHADUR (Stainless steels other than free-machining grades)—Bethlehem Steel Co., Bethlehem, Pa.

In bars and billets. For type, property and characteristics data, see "Stainless Steels" listing at end of this section.

BETHALON (Free-machining stainless steels)—Bethlehem Steel Co., Bethlehem, Pa.

In bars and billets. For type, property and characteristics data, see "Stainless Steels" listing at end of this section.

BETHANIZED (Electrogalvanized, zinc-coated wire)—Bethlehem Steel Co., Bethlehem, Pa.

BETHCO (Steel wire)—Bethlehem Steel Co., Bethlehem, Pa.

Barbed wire; machine screw wire; wood screw wire.

BETH-CO-LITE (Tin plate)—Bethlehem Steel Co., Bethlehem, Pa.

Cold-reduced tin plate, hot-dip and electrolytic coatings.

BETH-CO-WELD (Butt-welded steel pipe)—Bethlehem Steel Co., Bethlehem, Pa.

BETH-CU-LOY (Copper-steel sheets)—Bethlehem Steel Co., Bethlehem, Pa.

Contain 0.20 min copper, plain and galvanized.

BETHLEHEM (Steels and steel products)—Bethlehem Steel Co., Bethlehem, Pa.

Includes: Forgings, castings, bars and special sections, plates, flanged and dished heads, bolts, nuts, rivets and spikes, wheels and axles, frogs, switches and rails, steel sheets and strip, steel pipe, casing and tubing, tools, wire and wire products, wire rope, structural shapes, reinforcing bars, sheet and H-piles, fabricated steel construction.

In addition to the above products Bethlehem Steel Co. manufactures the following:

ALLOY STEELS; a complete line of electric furnace and open hearth steels including the entire range of AISI and SAE grades.

CARBON STEELS; all standard open hearth and bessemer carbon steels covering the complete AISI and SAE range.

CIRCULAR STEEL BLANKS; forged and rolled for the manufacture of gears, crane wheels, sheave wheels, flywheels, turbine rotors, tire molds and rings, brake wheels and drums, and other similar products.

STAINLESS STEELS; bars and billets in grades covering the entire range of AISI stainless steels. For type, property and

characteristics data, see "Stainless Steels" listing at end of this section.

TOOL STEELS; a complete range of carbon, low-alloy and high-alloy steels including carbon and carbon-vanadium tool and die steels, oil and air-hardening tool and die steels, shock-resisting steels, high-speed steels, hot-work steels, and special-purpose tool steels.

BETHLOC (Steel plate)—Bethlehem Steel Co., Bethlehem, Pa.

Low-carbon, high-ductility basic steel plates for standard railroad boiler-flange and firebox specifications.

BETHTELDUCTOR (High-tensile steel wire)—Bethlehem Steel Co., Bethlehem, Pa.

Electrolytic zinc coated. Used for telephone and telegraph lines.

BINNEY (Heat-resisting castings)—The Binney Castings Co., Toledo 7, O.

No. 71 and No. 73: heat-resisting alloy castings; weldability, good; heat-resistant to 2000 F; abrasion resistance, high. Used for construction parts for heat-treating furnaces and all applications requiring heat-resistant castings.

BIRDSBORO (Steel Castings)—Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.

Birdsboro "30" Steel: Steel castings to specifications; as normalized and drawn, ts, 85,000 psi; ys, 55,000 psi; elong in 2 in., 22%; machinability, good; weldability, good.

Birdsboro Carbon Steel: Steel sand castings to specification. As normalized, ts, 70,000 psi; ys, 30,000 psi; elong in 2 in., 24%; reduction of area, 36%; machinability, good; weldability, good.

Birdsboro 60-90: Steel sand castings furnished to specifications. As normalized and drawn, ts, 90,000 psi; ys, 60,000 psi; elong in 2 in., 22%; reduction of area, 45%; machinability, good; weldability, good.

BLAZECRETE (Gunning refractory) — Johns-Manville, New York 16.

For use as a gunning mixture in building new furnace linings and repairing old ones. Also unusually effective in heavy patching by troweling. Not recommended for casting purposes. Temperature limit, 3000 F.

BLUE ANCHOR (Drill rod) — Anchor Drawn Steel Co., Latrobe, Pa.

C 1.25, Si 0.25, Mn 0.25. Water-quenched and tempered; hardness, rockwell C, 65-67; abrasion resistance, medium; max cont serv temp, 300-500 F. For shafts, dowel pins, punches, dies, gages, etc.

BLUE RIDGE (Rolled patterned and wire glass)—Blue Ridge Glass Corp. Products sold by distributors of Libbey-Owens-Ford Glass Co., Toledo, O.

Glass furnished in sheet form for cutting and bending into parts; abrasion resistance, high; resists corrosion caused by everything except hydrofluoric acid; heat resistant to 130-154 F; flexibility, low; ts, 6500 psi; comp str, 36,000 lb per one-in. cube; moisture absorption, low; noninflammable; available in color; sp gr, 2.5; in transparent and translucent types. Used for covers and safety guards, utilizing polished wire glass, or tempered glass.

BOHNALITE (Aluminum base alloy)—Bohn Aluminum & Brass Corp., Detroit.

Light alloy of which aluminum is the base. For forged connecting rods, cast cylinder heads, crankcases, transmission cases, and parts for vacuum cleaners, washing machines, shoe machinery, etc.

BOOTH (Wool-base felt) — Booth Felt Co., Brooklyn, N. Y.

Furnished in sheets or strips for machining or stamping into parts; also precision-cut mechanical felt parts; heat resistant to 400 F; ts, 5-100 psi; available in colors in all standard SAE types and grades. Used for washers, gaskets, grease seals and pads for insulating machinery or reducing vibration.

BOROD (Hard facing alloy)—Stoody Company, Whittier, Calif.

A fabricated steel rod containing irregularly shaped particles of tungsten carbide of 40-125 screen size. Hardness, 9-10 on Moh's scale. Provides maximum abrasion resistance; widely used on earth working equipment, on coal cutter bits, cane knives and for hard-facing small or thin parts. For oxy-acetylene and d-c electric application.

BOUND BROOK (Bearing bronzes) — Bound Brook Oil-Less Bearing Co., Bound Brook, N. J.

Bushings, bearings and washers; cast bronze inlaid with hard graphite lubricant in grooves or holes of various designs; particularly adaptable to high temperatures, severe static loads, immersion in liquids, exposure to dusts or where oils are objectionable.

Graphited bronze bearings; Cu 81-85; Sn 6.25-7.5, Pb 6-8, Zn 2-4. Ts, 30,000 psi; ys, 14,000 psi; elong in 2 in., 12%; max cont serv temp, 500 F. For oil-less bearings in all types of machines.

BRANDYWINE (Fiber) — Brandywine Fiber Products Co., Wilmington, Del.

Vulcanized fiber and phenol fiber paper-base material; furnished in sheets, tubes and rods; for machining and forming into parts. Abrasion resistance, medium; resists corrosion caused by weak acids; heat resistant to 300 F; flexibility, medium; dielectric str, 300 volts per mil; moisture absorption, medium; available in red, gray and black; shatterproof; sp gr, 1.35; opaque; machinability, good; takes high polish. For small mechanical and electrical parts.

BRASSOID (Brass bonded to zinc)—American Nickeloid Co., Peru, Ill.

Brass serves as rustproof, flexible and inexpensive white metal base. Available in variety of brilliant finishes and patterns, as sheets, flat strips and coiled strip for continuous feed automatic presses. Can be supplied with quick removable, gum-adhered paper covering, permitting drawing and forming without marring prefinish.

BRIDGEPORT (Copper and zinc alloys)—Bridgeport Brass Co., Bridgeport, Conn. and Indianapolis, Ind.

Yellow brass; Cu 65, Zn 35; sheet, wire and seamless tubing for drawing, stamping and cold heading.

Cartridge brass; Cu 70, Zn 30. Sheet for making small arms ammunition, artillery cartridge cases, eyelet machine parts, etc.

Low brass; Cu 80, Zn 20; strip for drawing, spinning and stamping.

Rich low brass; Cu 85, Zn 15. Fine golden color; corrosion resistant. For vanity cases, inexpensive jewelry.

Free-cutting brass rod; Cu 60, Pb 3, balance Zn. For making automatic screw machine parts.

Forging rod; Cu 60, Pb 2, balance Zn.

Low brass; Cu 80, Zn 20; pale golden color. For parts requiring greater ductility and malleability than possessed by yellow brass.

Commercial bronze; Cu 90, Zn 10; bronze color for manufacturing stampings and drawn items and cold headed items, for outdoor use. Stands weathering better than yellow brass; copper sheet, rod, wire, seamless tubing for miscellaneous manufacturing.

Leaded brass alloys; contain from 0.25-0.375 Pb to facilitate machining.

Phosphor-bronze; Cu 92, Sn 8; for spring parts. Has better spring properties than lower tin content.

Phosphor-bronze; Cu 95, Sn 5. Sheet spring quality for manufacturing switch parts.

Copper sheets and tubes for fabricating.

Aluminum Bronze 712; supplied in strip form. Has excellent spring properties when cold rolled. Often replaces phosphor bronze spring metals.

Bronze welding rods in a variety of alloys for brazing iron and steel gears, frames, and other broken machine parts; for welding silicon bronze tanks.

BRIDGEPORT TUBING (Copper base tubing)—Bridgeport Brass Co., Bridgeport, Conn.

Condenser tubing; available in Admiralty metal for sea water, Cuzinal (aluminum brass) for harbor water, Muntz metal for fr water, Duronze IV for aerated brack water, Cupro-Nickel for most severe serv and U. S. Navy requirements, and Arsen copper for resisting corrosion better th straight copper in fresh water.

Duplex tubing; for two different types of co rosion inside and outside of tubing wh are too severe for a single alloy. Ste stainless steel, aluminum outside or ins in combination with Admiralty brass, al minum brass, copper or cupro nickel, us for oil refining, refrigeration systems, che ical plants and food processing.

Copper water tubing; for industrial applic tions, and for pipe lines on board ship; al for air conditioning, plumbing and heati lines.

Brass and copper pipe for plumbing and hea ing lines.

BRONZOCHROM (Hard facing rod)—Eutec Welding Alloys Corp., New York 13.

For hard overlaying against frictional we on ferrous and nonferrous metals. Th rods have low bonding temperature. Wel are hard and have low frictional coef cients. Can be applied in thin layers wit out distortion or stresses.

BUFFALO (Wire cloth)—Buffalo Wire Wor Co., Inc., Buffalo.

Wire cloth for every industrial use. Scree for abrasive material, chemicals and powde in plain steel, tinned, brass, copper, bronz Monel and stainless steel. Also galvanize after-woven wire cloth.

BUFLOKAST (Alloy cast iron)—Buflovak Equip ment Div., Blaw-Knox Co., Buffalo 1 N. Y.

Furnished as sand castings to suit specifica tions. Heat-treated, ts, 30-60,000 psi; Bh 160-300; max cont serv temp, 1500 F abrasion resistance, medium.

BUNDYFLEX (Tubing)—Everhot Products Co. Chicago 12, Ill.

Copper fused and copper coated on both insid and out steel tubing which can be bent t any shape, hard or soft soldered, braz or welded and used for many purposes fo which ordinary copper tubing was previousl required. Strong and has high resistance t vibration fatigue. Used on passenger car and trucks as fuel lines, oil filter lines, hy draulic brake lines, etc. Also on oil burners refrigerators, farm tractors, airplanes, et

BUNDYWELD (Tubing)—Bundy Tubing Co. Detroit.

Steel tubing; of SAE 1010 steel, in sizes ¼ to ⅝ OD, in wall thicknesses from 0.02 to 0.049-in.

Monel tubing; in sizes ⅛ to ⅝-in. OD.

"L" Nickel tubing; in sizes ⅛ to ⅝-in. OD

BUNTING (Bearing bronzes)—The Bunting Brass & Bronze Co., Toledo, O.

Precision-machine cored and solid bar stock. Over 1000 sizes of standardized fully-finished stock bearings for machinery applications. All cast in accordance with bearing bronze specification SAE 660 (QQB-691 Grade 12). Special sizes made to blueprint from SAE, AMS, ASTM, Federal, Navy and Air Corps specifications and from the company's recognized standard bronze bearing alloys, as follows:

No. 72, SAE 660: Cu 83, Sn 7, Pb 7 and Zn 3. General-purpose bearing bronze.

No. 27: Cu 80, Sn 10 and Pb 10. General-purpose bearing bronze.

No. 96: Cu 87.5, Sn 10, Pb 2.5. Hard leaded bronze for heavy pressures and moderate speeds. Good physical properties fit it for heavy duty equipment such as diesel engine piston pin bushings, connecting rod liners, valve guides, etc.

No. 98: Cu 88, Sn 10 and Zn 2. Hard bronze for severe service and heavy pressures. An allowance of 1 per cent lead content improves machinability and bearing characteristics without impairing the physicals. Used in aviation engines.

No. 124: Cu 85, Sn 5, Pb 9 and Zn 1. Ex-

cellent in automotive camshaft and piston pin applications.

No. 125: Cu 75, Sn 5 and Pb 20. Good antifriction properties.

No. 135: Cu 77, Sn 8, Pb 15. Furnished in the form of finished bushings and bearings. Ts, 28,000 psi; comp str, 18,000 psi; ys, 14,000 psi; elong in 2 in., 15%; bhn, 52; machinability, good. Suited to medium load and speed conditions. For steel rings, marine propeller shaft strut bearings, etc.

No. 164: Cu 86, Sn 11, Pb 1.5, Ni 1.5. Gears and synchronizer rings.

No. 158: Cu 70, Sn 5, Pb 25. Connecting rod liners, water pump bushings and seals.

No. 178: Cu 68, Sn 4 and Pb 28. Main and connecting rod applications.

No. 170: Pb 75, Sn 10 and Sb 15; babbitt metal.

No. 116: Sn 86, Cu 7 and Sb 7; genuine babbitt metal.

Cast bronze; Cu 64, Sn 4, Pb 4, Zn 8, Ni 20. Furnished as sand castings to specification. Ts, 45,000 psi; ys, 27,000 psi; elong in 2 in., 15%; Bhn, 95; nonmagnetic; is not weldable; abrasion resistance, medium. Used for bearings in contact with certain corrosive fluids and gases.

Aviation and machine tool bearings and transmission cones are sand, chilled or centrifugally cast and machined to the utmost precision dimensions and surface finishes.

BUTACITE (Polyvinyl butyral plastic)—E. I. du Pont de Nemours & Co., Inc., Arlington, N. J.

Polyvinyl butyral, thermoplastic; furnished in sheets and flakes for adhesive coatings and laminating. Soluble in esters, alcohols, ketones, chlorinated hydrocarbons; insoluble in aliphatic hydrocarbons; stable in dilute alkalis and slowly decomposed in dilute acids. Dielectric str, 360 volts per mil; ts, 2000 psi; moisture absorption, high; sp gr, 1.07; transparent. Used for safety glass.

BUTAPRENE (Synthetic rubber)—Firestone Tire & Rubber Co., Akron.

For molding, extruding, calendering and spreading. Has extremely high resistance to fuels and oils; high abrasion resistance when properly compounded; resists corrosion caused by most acids, alkalis and salts; heat resistant to 275 F; flexibility, high; ts, up to 3500 psi; moisture absorption, low; takes color; shatterproof at temperatures above —40 F; sp gr, 0.96-1.0; translucent. For all automotive and aeronautical rubber parts requiring resistance to oils and fuels and marine and filling station pumps.

BUTYL (Rubber)—Enjay Co. Inc., New York 19.

Isobutylene-isoprene copolymer. Furnished in sheet form; has notable resistance to ozone, acids, alkalis and many fats and vegetable oils; max cont serv temp, 300 F; flexibility, high; dielectric strength (volts per mil. inst), 600; ts, 100-3000 psi; elong, 50-900%; natural color is dark amber, but various colors can be produced by compounding; sp gr, 0.92; is translucent; hardness, 10-80 Shore Durometer A. Used for vibration dampening, electrical insulation, conveyor belting, rolls, flexible couplings, boots, air hose, steam hose, plywood forming bags, diaphragms. Major use in automobile inner tubes where resistance to heat and passage of air are important. (Enjay Company, Inc. furnishes information and technical service on Butyl, which is sold only through the Reconstruction Finance Corporation. Office of Rubber Reserve.)

B & W (Firebrick)—The Babcock & Wilcox Co., Refractories Div., New York 6.

Ceramics furnished in standard or special refractory shapes; fabricated by molding and kiln firing.

Junior Firebrick; serv temp, 2925 F; fusion point 3173 F; conductivity, Btu/sq ft/hr/deg F/in. at mean temp of 1600 F, 11.50; high melting point; high creep strength; and low volume change at elevated temperatures.

80 Firebrick; serv temp, 3000 F; fusion point, 3190 F; conductivity, Btu/sq ft/hr/deg F/in. at mean temp of 1600 F, 12.75; has high melting point, high creep strength; and low volume change at elevated temperatures.

Insulating Firebrick; furnished in various grades, ranging in serv temp from 1600-2900; fusion points from 2700-3190 F; conductivity, Btu/sq ft/hr/deg F/in. at mean temp of 1500 F, 1.24-3.15; cold crushing strength, 48-308 psi; modulus of rupture, 41-283 psi. All have high resistance to heat flow: are lightweight, and have low heat storage.

All are used for linings in all types of furnaces for industries such as ceramics, gas generators, chemicals, oil refining, power, steel producing and processing, etc.

B & W 5202 (Alloy cast steels)—The Babcock & Wilcox Co., New York 6, N. Y.

High carbon, alloy steel castings. In machined and final heat treated state: Ts, 200,000 psi; Bhn, 500-600. High abrasion resistance. For grinding and crushing machinery.

B & W CROLOY (Steel tubing)—The Babcock & Wilcox Tube Co., Beaver Falls, Pa.

½: C 0.10-0.20, Cr 0.50-0.70, Mo 0.45/0.65, Si 0.10-0.30; principally used for high-temperature piping; useful to 1000 F in steam, slightly higher in oil refining; superior to carbon molybdenum with respect to graphitization and high-temperature load-carrying ability.

1: C 0.15 max, Cr 0.80-1.10, Mo 0.45-0.65, Si 0.30 max; principally used for high-temperature piping and boiler and superheater tubes.

1¼: C 0.15 max, 1-1.5, Mo 0.45-0.65, Si 0.5-1; useful to 1025 F in steam, slightly higher in oil refining; has fair creep strength where limited corrosion and oxidation resistance are required.

2; C 0.15 max, Cr 1.75-2.25, Mo 0.45-0.65, Si 0.5 max; for refinery and superheater tubes. Corrosion and heat-resistant at nominal temperatures.

2¼; C 0.15 max, Cr 2-2.25, Mo 0.9-1.1, Si 0.5 max; for refinery and superheater tubes where high creep strength is required.

3M; C 0.15 max, Cr 2.75-3.25, Mo 0.8-1, Si 0.5 max; suitable from 1000 to 1050 F in steam or to 1175 F in refinery applications; good creep properties and corrosion resistance superior to Croloy 2 or 2¼.

5; chromium molybdenum; C 0.15 max, Cr 4-6, Mo 0.45-0.65; for oil refinery service and for steam superheaters; good creep properties and resistance to oxidation. Temperature limits, about 1050 F for steam and 1200 F for refinery applications.

7; C 0.15 max, Cr 6-8, Mo 0.45-0.65; for oil refinery service where increased corrosion resistance is required.

9; C 0.15 max, Cr 8-10, Mo 0.90/1.10, 1.05/1.30, 1.20/1.50; semistainless alloy of good physical properties and corrosion resistance.

Also stainless steel tubing, seamless and/or welded furnished to AISI types. For information on types, properties and characteristics see "Stainless Steels" listing at end of this section.

BYERS GENUINE (Wrought iron)—A. M. Byers Co., Pittsburgh 30.

Two-component metal of high purity iron and iron silicate, furnished as pipe, tubing, plate, sheets, finished rods or bars and blooms or billets for forging. Magnetic; good weldability. Resists corrosion caused by various chemical and electro-chemical reactions: abrasion resistance, high. For any part where resistance to corrosion and/or fatigue is essential.

C

CALITE (Heat-resisting cast steels)—Calorizing Co., Pittsburgh.

"A"; A Ni-Cr alloy (Ni 35, Cr 16); good creep strength; useful at temperatures up to 2000 F; bhn (as cast), 200. For hearth plates, enameling supports, chain, and general mechanical parts in furnaces. Also available in rolled bar stock.

"B-28"; Cr 25, Ni 10, Mo 1.00; for furnace parts operating at temperatures up to 1950 F. Combines great high temperature strength with freedom from embrittling tendency in service.

"B-29"; for furnace parts operating at temperatures up to 2050 F.

"N"; available in sheets, bars and castings. For parts operating at temperatures up to 2100 F, particularly parts subject to uneven heating or rapid, irregular temperature changes.

"E"; available in bars and sheets for parts subject to temperatures up to 1600 F.

"E-28"; available in bars and sheets for parts subject to temperatures up to 1950 F.

CALSTRIP (Carbon steel) — California Cold Rolled Steel Corp., Los Angeles 22.

Low carbon cold-rolled steel furnished in straight and coiled strip. For low-strength parts requiring high ductility and softness. Has good formability.

CAMBRIDGE (Flexible wire cloth)—Cambridge Wire Cloth Co., Cambridge, Md.

A flexible wire cloth used for conveyor belts in processing, mechanical, food, glass, ceramic and metalworking fields.

CARBOCELL (Porous carbon)—National Carbon Co., Inc., New York 17.

Available in a variety of standard and special elements in several pore size grades. Elements include open and blind-end tubes, rods up to 36 in. in length and 6⅝ in. in diam., plates with maximum dimensions of 12 x 12 x 1½ in., and blocks 14 x 14 x 9 in. Easily machined and fabricated into shapes; resistant to acids and alkalies; not subject to fracture and spalling from thermal shock. For use in filtration or corrosive liquids and gases and in conditions where thermal shock may be expected in chemical and process industries.

CARBOLOY (Cemented carbide) — Carboloy Company, Inc., Detroit.

A series of cemented carbides basically made from tungsten carbide and a softer cementing element such as cobalt. In certain grades, supplementary ingredients are the carbides of tantalum, titanium or other metals. Has high resistance to abrasive wear; outstanding because of its extreme hardness, compressive strength being as high as 800,000 psi. Rockwell hardness on "A" scale, 86-93. Does not rust or corrode under normal conditions. Has moduli of elasticity and torsion approximately three times that of steel thus providing great rigidity. Suitable for use where high rigidity, density and abrasive resistance are required such as facings for valve lifters and valve ends in automotive engines, cam followers, ceramic molds, cold forging dies, guide rings, spray nozzles, valve seats and valves, powder metal molds and plungers, boring bars, etc.

CARCOLOY (Alloy iron casting)—Pacific Car & Foundry Co., Renton, Wash.

Furnished as sand castings to specification; properties, as cast; ts, 55-85,000 psi; bhn, 265-345; weldability, fair; has high damping capacity and fatigue ratio. For diesel engine crankshafts and similar reciprocating parts subject to high torsional vibration.

CARCOMETAL (Alloy steel castings) — Pacific Car & Foundry Co., Renton, Wash.

Furnished as sand castings to specification; in heat treated state; ts, 80-150,000 psi; ys, 60-140,000 psi; elong in 2 in., 15-35%; imp str (Izod), 40-70 ft-lb; bhn, 160-450; weldability, good; max cont serv temp, 450 F; abrasion resistance, high. Principally recommended for structural castings requiring high elastic strength and fatigue properties where thin wall sections and extreme lightness are required.

CARDOLITE (Resins)—Irvington Varnish & Insulator Co., Irvington, N. J.

Derived from cashew nut shell liquid, a high molecular weight unsaturated material with phenolic characteristics. Includes brake-lining binders, friction fortifiers and types used in manufacture of electrical insulation; laminating, impregnating and sealing resins.

CARPENTER (Stainless and alloy steels)—The Carpenter Steel Co., Reading, Pa.

Stainless Steels in standard forms. For type, property and application data on these see "Stainless Steels" listing at end of this section.

Presto: C 1.05, Cr 1.4; for ball and roller bearings.

Silico-manganese steel; C 0.6, Mn 0.75, Si 2. For heavy-duty springs.

No. 5-317; chrome-nickel steel; C 0.5, Ni

1.75, Cr 1. For gears, clutches and shafts.

No. 4-408; C 0.4; Ni 3, Cr 0.75. For clutches and shafts.

No. 158; C 0.1, Ni 3.5, Cr 1.5. For case-hardened high-duty clash gears, shafts and clutch parts.

No. 2 Sampson: C 0.2, Ni 1.25, Cr 0.6. For case-hardened gears, roller bearings, pneumatic tool parts, etc.

No. 4 Samson steel; C 0.4, Ni 1.25, Cr 0.6. For side links of silent chains, shafts, etc.

No. 3-547; nickel-steel; C 0.3, Ni 3.5. For heat-treated shafts, etc.

No. 2-547; case-hardening nickel-steel; C 0.2. Ni 3.5. For small parts requiring hard surface and tough core.

No. 500; C 0.1, Ni 5. For turbine blades, case-hardened gears, etc.

Chrome-vanadium 5-720; C 5, Cr 0.9, V 0.2. For leaf and coil springs, gears, shafts, etc.

No. 3-247; chrome-molybdenum-steel; C 0.3, Cr 1, Mo 0.2. For aircraft and automotive parts.

No. 436; C 0.15, Ni 1.75, Mo 0.25. For case-hardened parts.

Temperature compensator alloy; iron-nickel alloy; furnished in rough bars or billets, finished rods or bars, wire and strips for hot forging, stamping, turning, boring, etc.; permeability varies inversely as temperature. For magnetic shunts for meters, speedometers, tachometers, voltage regulators, etc.

Stainless No. 20; Ni 29, Cr 20, Mo 2 min., Cu 3 min., Si 1, Mn .75, and C .07. Furnished in finished rods or bars, straight and coiled strip, tubing, wire and sheet. In cold-worked state, ts is 85,000 psi; ys, 35,000 psi; elong in 2 in. 35-50% and bhn, 150-180. Sp gr, 8.02; weldability, good; resists corrosion caused by sulphuric acid. Used for pump parts, shafts, rods, valve stems, bolts, nuts, etc.

CARRARA (Structural glass)—Pittsburgh Plate Glass Co., Pittsburgh 19.

Plate glass generally chemical resistant; noninflammable; low flexibility; ts, 3500 psi; moisture absorption, low; available in black, white, ivory, gray, beige, jade, forest green, wine, orange and Rembrandt blue; sp gr at 70 F, 2.43. For work surfaces, separators, etc.

CATABOND (Bonding resin)—Catalin Corp. of America, New York.

Phenolic base, thermosetting; furnished as liquid resin for laminating and bonding; noninflammable; moisture absorption, low; fungi resistant. Used for abrasive wheels, laminated products, surface coating, impregnating and bonding.

CELANESE (Thermoplastic laminates)—Celanese Corp. of America, Plastics Div., New York 16.

Cellulose propionate and cellulose acetate in laminated sheets. Have good chemical resistance; Ts, 65,000 psi; produced in wide range of translucent and opaque colors; moisture absorption, medium; machinability, good. Used for housings, paneling, covers, etc.

CELCON (Ethyl cellulose plastics)—Celanese Corp. of America, Plastics Div., New York 16.

Available in continuous sheeting and in granules for injection molding and extruding. Abrasion resistance, medium; good resistance to alkalies and weak acids, wide solubility in organic solvents; max cont serv temp depends on use and formula; flexural str, 4000-12,000 psi (ASTM D 650-42T); dielectric str, 400-520 volts per mil (⅛-in. thickness); ts, 2700-8000 psi; comp str, 8000-20,000 psi; impact str, 5.6-11.6 ft lb (Izod); available in all colors except crystal and pale pastels; moisture absorption, low; sp gr, 1.07-1.18; machinability, good. Used for electrical insulation, housings and parts, motor housings, etc.

CELITE (Diatomaceous silica materials)—Johns-Manville, New York 16.

Furnished in powdered, granular and brick forms; resistant to chemical corrosion; heat-resistant; noninflammable. Brick used for insulation of equipment operating at high temperatures; powder used as filter-aid for cutting fluid purification, fillers, etc.

CELL-TITE (Soft and hard rubber)—Sponge Rubber Products Co., Shelton, Conn.

Soft rubber, thermosetting; furnished in sheets, rods or tubes. Abrasion resistance, low; resists corrosion caused by acids and alkalies; flexibility, high; ts, to 150 psi; moisture absorption, very low; available in color; shatterproof; sp gr, 0.165-0.5; opaque; machinability, fair. For insulation.

Hard; thermosetting and thermoplastic; in sheets, rods or tubes and in laminated and molded (board) form. Abrasion resistance, low; resists corrosion caused by acids, alkalies; heat resistant to 285 F; flexibility, medium; ts, 100-300 psi; comp str, 100-450 psi; flex str, 500-1500 psi; moisture absorption, low; shatterproof; sp gr, 0.08-0.50; opaque. For insulation.

CELLULAK (Shellac thermosetting material)—Continental-Diamond Fibre Co., Newark 23, Del.

Furnished in tubes, for compression rolling. Abrasion resistance, medium; resistant to oils and greases. Max cont serv temp, 180 F; dielectric strength, 750 volts per mil; machinability, fair; opaque. For electrical insulation and oil resistant spacers.

CELLULOID (Cellulose-nitrate base plastics)—Celanese Corp. of America, Plastics Div., New York 16.

Thermoplastics; furnished in sheets, rods, tubes and films; for forming, swaging, veneering, machining or stamping into parts; available in colors, transparent, translucent and opaque. Abrasion resistance, medium; good resistance to sulphuric acid; soluble in lower alcohols, esters and ketones, insoluble in hydrocarbons. Max serv temp depends on conditions; flexural str 6000-15,000 psi (ASTM D 650-42T); dielectric str 300-400 volts per mil (⅛-in. thickness); ts, 3000-11,000 psi; comp str, 20-30,000 psi; impact str, 2-6 ft lb (Izod); low moisture absorption; sp gr 1.35-1.57; machinability, good; bhn 5-11. For buttons, instrument dials, register wheels, etc.

CEL-O-GLASS (Plastic-coated wire mesh)—E. I. du Pont de Nemours & Co., Wilmington, Del.

Transmits ultra-violet rays; corrosion-resistant; resistant to shock; translucent; flexible; light in weight. Used where an opalescent or translucent, flexible material is required.

CELORON (Thermosetting plastics)—Continental-Diamond Fibre Co., Newark 23, Del.

Phenol formaldehyde, thermosetting; furnished in sheet, rods, tubes for compression and transfer molding into parts, also molded parts and laminated forms; abrasion resistant; resistant to gasoline, kerosene, oil, grease, alcohol, acids and weak alkalies. Max cont serv temp, 250 F; flexural str, 21,000 psi (ASTM D-229-42); dielectric str, 220 volts per mil; ts, 11,000 psi; comp str, 40,000 psi; impact str, 3.6 ft-lb (Izod); available in mottled tan and black; moisture absorption low; sp gr 1.35; opaque. Used for electrical insulation, gears, pinions, cams, bushings, pulleys, casters, clutches, filter plates, handles, housings, etc.

CEMCO (Aluminum alloys)—The Cleveland Electro Metals Co., Cleveland 13.

Aluminum alloys to specification in the form of pig or ingot, rough bars or billets, and permanent-mold castings.

CENTRALINE (Wood-cellulose fiber)—Central Paper Co., Inc., Muskegon 28, Mich.

Wood-cellulose fiber, bleached or unbleached, or of specialty fiber; furnished either coated or saturated with plastic materials; in rolls or sheets, both plain and laminated of two or more thicknesses; abrasion-resistant; resists corrosion caused by atmospheric conditions; heat-resistant; flexible or stiff; low dielectric strength or as high as 500 volts per mil depending on final thickness of paper; ts, 7500-8500 psi; moisture absorption, varied; available in color; translucent or opaque. Used for coils, motors, gaskets, shims, non-corrosive separations, insulating, filtering, etc.

CENTRALLOY (Alloy iron castings)—Centrifugal Foundry Co., Muskegon, Michigan.

C 3.00-3.40, Si 1.80-2.40, Mn 0.6-1.0, S 0.12 max, P 0.12-0.30 max, Cr 0.15-0.75, Ni 0.15-1.0, Mo 0.15-0.40, Cu 0.15-1.50. Furnished as permanent-mold castings. Castings generally heat-treated before shipment. In heat-treated state, ts, 50,000 psi; Bhn, 187-300; max cont serv temp, 700 F; abrasion resistance, high. For piston rings, cylinder sleeves, etc.

CERAWARE (Ceramics)—General Ceramics & Steatite Corp., Keasbey, N. J.

Ceramic material for molding, casting, machining and extruding; abrasion resistance, high; resists corrosion except by hydrofluoric acid and caustic alkalies; flexibility, low; heat resistant to 250 F; ts, 200 psi; compressive str, 80,000 psi; moisture absorption, low; sp gr, 2.2; opaque; machinability, grinding only. Used for chemical equipment generally.

CEREX (Heat-resistant thermoplastic) — Monsanto Chemical Co., Plastics Div., Springfield 2, Mass.

Molding granules for injection and extrusion molding; adaptable to automatic machine blowing. Markedly better heat resistance than other thermoplastics; in general molded parts may be boiled without loss of shape or strength. Color range includes colored transparents, translucents and opaques. Excellent dimensional stability. Somewhat improved mechanical properties over polystyrene including better shock strength; electrical properties better than any other rigid thermoplastic except Lustron.

CERROBASE (Low-melting-point alloy)—Cerro de Pasco Copper Corp., New York.

Bismuth-lead casting alloy which expands on cooling; melts at 255 F; ts, 6100 psi. Recommended for autoclaves, liquid seal for nitriding furnaces, electroforming, etc.

CERROBEND (Low-melting-point alloy)—Cerro de Pasco Copper Corp., New York.

Bismuth-lead-tin-cadmium casting alloy which expands on cooling and has the extremely low melting temperature of 160 F; ts, 6000 psi. Useful as a fusible alloy and as a filler for tube bending.

CERROLOW-117 (Low-melting-point alloy) — Cerro de Pasco Copper Corp., New York.

Bismuth-lead-tin-cadmium-indium alloy furnished in cake and ingot and formed by casting. Melts at 117 F; ts, 5400 psi; Bhn, 12; weight, 0.32 lb per cu in.; shrinkage upon cooling of 0.0002-in. per in. makes it useful for proof casting. Used as fusible alloy in thermal safety devices, alarms, etc.

CERROMATRIX (Low-melting-point alloy)—Cerro de Pasco Copper Corp., New York.

Bismuth-lead-tin-antimony casting alloy which melts at 248 F and expands on cooling; ts, 13,000 psi. Used for locating and anchoring punches in dies and machine parts in cored holes.

CERROSAFE (Low-melting-point alloy) — Cerro de Pasco Copper Corp., New York.

Bismuth-lead-tin-cadmium alloy furnished in cake or ingot and formed by casting. Ts, 5400 psi; ys, 300 psi; Bhn, 9; weight, 0.341 lb per cu in.; is nonmagnetic. Shrinks slightly on solidification, grows in one hour to original cold-mold dimensions. Used as proof casting medium, spray coating of wood patterns and core boxes, duplicate patterns in making match plates.

CERROSEAL (Metal-to-glass solder)—Cerro de Pasco Copper Corp., New York.

Indium-tin alloy furnished in cake or ingot form; melts between 240 and 250 F. Adheres to glass and used to join glass to glass, and glass to metal for vacuum seals.

CERROTRU (Low-melting-point alloy)—Cerro de Pasco Copper Corp., New York.

Bismuth-tin alloy furnished in cake or ingot and formed by casting. Melts at 281 F; ts, 8000 psi; ys, 500 psi; Bhn, 22; Expands 0.0007-in. per inch during solidification, shrinks to 0.0005-in. in cooling to room temperature.

CHACE (Thermostatic bimetal)—W. M. Chace Co., Detroit 9.

A number of combinations including alloys of nickel-iron, nickel-iron-chromium, nickel-

iron-manganese, pure nickel, brass, bronze, etc.; responsive to various temperature ranges and provide a wide range of deflection rates and electrical resistivities. For temperature control elements in controllers, recorders, indicators, etc.

CHAMET (Bronze)—Chase Brass & Copper Co., Waterbury 91, Conn.

Type A; Cu 60.5, Sn 0.75, Zn 38.75. For shafting and structural and engineering uses.

Type B; Cu 63.5, Sn 0.75, Zn 35.75. For general cold heading and upsetting purposes.

CHASE (Brasses and bronzes) — Chase Brass & Copper Co., Waterbury 91, Conn.

Leaded commercial bronzes; Cu 89, Pb 2, Zn 9; for screw machine parts requiring good physical properties and high corrosion resistance.

Also various high and low brasses and bronzes in various forms to meet specific requirements for a variety of mechanical parts.

CHASE TELLURIUM COPPER—Chase Brass & Copper Co., Waterbury 91, Conn.

Cu 99.5, Te 0.5. Furnished in finished rods or bars and tube for hot forging, extruding, turning, boring, etc.; corrosion resistant; medium abrasion resistance; ts, 32-55,000 psi; medium ductility; Bhn, untreated, 90. For electrical connections, parts for electric motors, switches, etc.

CHEMACO (Thermoplastic plastics)—Chemaco Corp., Berkeley Heights, N. J. Also Koppers Co. Inc., Chemical Div., Pittsburgh 19.

Cellulose acetate; thermoplastic. Furnished in granules for molding and extruding. Abrasion resistance, high; resists corrosion caused by weak acids, weak alkalies and hydro carbons; flexural str, 1500-12,000 (ASTM D 650-42T); dielectric str, 290-365 (⅛-in. thickness); ts. 3000-10,000 psi; comp str, 5000-30,000 psi; moisture absorption, medium; produced in color; sp gr, 1.27-1.37; transparent, translucent and opaque; machinability, excellent. For knobs, dials, controls, wheels, electrical insulation, shields, nameplates, washers, housings, etc.

Ethyl cellulose; thermoplastic. Furnished in granules for molding and extruding. Abrasion resistance, low; resists corrosion caused by weak acids and alkalies; heat resistant to 140-220 F; flexibility, low; flexural str, 3500-12,000 psi (ASTM D-650-42T); dielectric str, 400-700 volts per mil; (⅛-in. thickness); impact str, 6-11.5 ft lb (Izod); ts, 3000-10,000 psi; comp str, 8000-20,000 psi; moisture absorption, low; produced in pastels, sp gr, 1.07-1.18; translucent; machinability, good. For knobs, controls, trim, nameplates, etc.

Polystyrene; thermoplastic. Furnished in granules for molding and extruding. Abrasion resistance, high; resists corrosion caused by alkalies and weak acids; heat resistant to 150-190 F; flexural str, 8000-19,000 psi (ASTM D 650-42T); dielectric str, 3500 volts per mil (0.005-in. thick); ts 5000-9000 psi; comp str, 11,500-15,000 psi; moisture absorption, low; produced in color; sp gr, 1.054-1.056 (unpigmented); transparent, translucent and opaque. For use as knobs, dials, controls, wheels, electrical insulation, shields, etc.

CHEMALLOY (Cast stainless steel)—Electro-Alloys Div., American Brake Shoe Co., Elyria, O.

F, A and H series: Ferritic, austenitic and nickel-base alloys furnished in sand castings to specifications.

CHEMALLOY N SERIES (High-alloy cast iron)—Electro-Alloys Div., American Brake Shoe Co., Elyria, O.

Furnished in form of sand castings to specification. Sp gr, 7.3-7.4; machinability, good; weldability, fair; max cont serv temp, 1500 F; abrasion resistance, high. Has good corrosion resistance; is anti-galling.

CHEMIGUM (Synthetic rubber)—Goodyear Tire & Rubber Co., Akron 16, O.

Butadiene acrylonitrile, synthetic rubber; thermoplastic; for molding and extruding into parts. Abrasion resistance, high; resists corrosion caused by acids, alkalies and oils. Good low-temperature flexibility; ts, 3500 psi; moisture absorption, low; nonstaining. For gaskets, seals, vibration dampeners, hose, tubing and general rubber compounding.

CHLORIMET No. 3 (Ni-Cr-Mo cast alloys)—The Duriron Co., Inc., Dayton 1, O.

Ni 60, Mo 18, Cr 18, Fe 3, C 0.07. Furnished in sand castings to suit specifications. Ts, 75,000 psi; ys, 50,000 psi; elong in 2 in., 10%; Bhn, 225; nonmagnetic; weldability, good; resists most acids, particularly under oxidizing conditions.

No. 2 (Ni-Mo cast alloy)—Ni 62, Mo 32, Fe 3, C 0.10. Furnished as sand castings to specifications; ts, 80,000 psi; ys, 55,000 psi; elong in 2 in., 5%; Bhn, 250; nonmagnetic; weldability, good; resists hydrochloric acid at all concentrations and temperatures, hot sulfuric acid under reducing conditions, and wet hydrogen chloride gas.

CHROMALOID (Chromium bonded to nickel-bonded zinc) — American Nickeloid Co., Peru, Ill.

Chromium serves as rustproof, flexible and inexpensive white metal base. Available in variety of brilliant finishes and patterns, as sheets, flat strips and coiled strip for continuous feed automatic presses. Can be supplied with quickly removable, gum-adhered paper covering, permitting drawing and forming without marring pre-finish.

CHROMAX (Nickel-chromium steel) — Driver-Harris Co., Harrison, N. J.

A heat-resisting alloy used for carburizing containers or furnace parts; Ni 35, Cr 19, and balance Fe.

CHROMEL (Nickel base and nickel-chrome steels)—Hoskins Mfg. Co., Detroit 8.

Alloy 502: Ni 35, Cr 18½, balance mainly Fe; supplied as castings, or as rod, bars, and strips. For general heat-resistant applications and for mechanical and load-carrying members.

Alloy 651: Pure nickel having 99+% nickel; furnished in ribbon strips and wire, for machining, stamping, drawing, bending and forming. In untreated state: Ts, 60,000 psi; sp gr, 8.86; magnetic; weldability, fair.

Alloy 667: Nickel alloy of Mn 4, Si 1, Ni balance. Furnished in ribbon strip and wire, for machining, stamping, drawing, bending and forming, resistance welding and brazing. In untreated state: Ts, 75,000 psi; sp gr, 8.40; magnetic; resists corrosion caused by automotive combustion gases. Used for spark plugs and electrode wire.

Alloy 670: Cr 25, Ni 12, balance mainly Fe; supplied as castings or as rod, bars and strips. For high-temperature applications where sulphur corrosion must be withstood.

Grade A: Ni 80, Cr 20; supplied as castings or as rod, bars, wire and strip. Used for electric heating elements to 2100 F.

Grade C: Ni 60, Cr 16, balance mainly Fe. Used for electric heating elements to 1800 F; also for rheostatic purposes; supplied as castings, or as rods, bars and strip.

Grade D: Ni 35, Cr 18½, balance mainly Fe. Used for heating elements to 1600 F; available cast, or as wire, rod and strip, and welding wire. For mechanical purposes where heat resistance or load-carrying ability while hot are of importance.

CHROME-VANADIUM (Alloy tool steel) — Vanadium-Alloys Steel Co., Anchor Drawn Steel Co., Colonial Steel Div., Latrobe, Pa. Pa.

Available in Types D, G, H, K, N and BB, with analyses of C 0.50-1.00, Si 0.25, Mn 0.30, Cr 0.80-1.20 and V 0.20. Furnished in rough bars or billets, finished rods or bars, wire, sheet, plate, forgings and drill rod; for precision casting, machining, hot and cold working, stamping, drawing and brazing. Water or oil-quench, depending upon carbon content, 1425-1550 F; temper 300-1300 F. Hardness, rockwell C, 55-67 max, depending on carbon content. Magnetic; weldability, fair; max cont serv temp, 300-500 F. For bearings and high grade machine parts.

CIBANITE (Plastics molding powder)—Ciba Co. Inc., New York 14.

Aniline formaldehyde resin, thermoplastic, furnished in powder form for molding. Abrasion-resistant; resists corrosion caused by alkalies; heat-resistant up to 247 F; flexibility, low; dielectric strength, 400-600 volts per mil; ts, 8200 psi; comp str, 24,000 psi; moisture absorption, 0.01-0.08 per cent; available in natural brown color; impact str, 0.30 ft lb; sp gr, 1.22-1.25; translucent; machinability, good. For use where good strength with electrical properties are required, such as for stator insulation, tube bases, coil forms, terminal boards, strips and blocks.

CIMET (Chromium-nickel steel castings) — Driver-Harris Co., Harrison, N. J.

Ni 10-12, Cr 26-28, and balance Fe. Castings for high-temperature furnace parts.

CIRCLE L (Stainless steel alloys) — Lebanon Steel Foundry, Lebanon, Pa.

A series of wear, corrosion and heat-resistant, and stainless steel alloys in casting form, used especially for chemical and general processing equipment. Properties of the various grades are as follows: (Composition gives essential elements other than iron)

A; C 0.4; Mn 0.7; ts, 85,000 psi; bhn, 170; for steel castings.

B; C 0.25, Si 0.40, Mn 0.65; ts, 65,000; bhn, 135; for steel castings.

No. 3; C 0.40, Cr 1.00, Mo 0.25, Mn 0.70; ts, 110,000 psi; bhn, 200-300; for straightening dies, cams, gears, hot pressing and light forging dies.

No. 205A; C 0.3, Si 0.4, Mn 0.8, Ni 0.6, Cr 0.6, Mo 0.20; ts, 85,000 psi; bhn, 185; for steel castings.

No. 205B; C 0.30, Si 0.4, Mn 0.8, Ni 0.6, Cr 0.6, Mo 0.2; ts, 105,000 psi; bhn, 225; for steel castings.

No. 205C; C 0.30, Si 0.4, Mn 0.8, Ni 0.6, Cr 0.6, Mo 0.2; ts, 120,000 psi; bhn, 260; for steel castings of high physical properties.

No. 205 D; C 0.30, Si 0.4, Mn 0.8, Cr 0.6, Ni 0.6, Mo 0.2; ts, 150,000 psi; bhn, 320; for castings of superior physical properties.

No. 206; C 0.15, Mn 0.8, Cr 0.6, Ni 0.6, Mo 0.2; for castings to be carburized.

No. 7; C 0.07, Mn 0.25, Si 0.6; ts, 48,000 psi; bhn, 120; for electrical parts.

No. 8; C 0.15, Cr 2.75, Mo 0.4; ts, 85,000 psi; bhn, 190; for temperatures up to 1000 F.

No. 9; C 0.20, Mn 0.65, Mo 0.5; ts, 65,000 psi; bhn, 135; for turbines, valves and fittings.

No. 10; C 0.20, Cr 5.50, Mo 0.50; ts, 90,000 psi; bhn, 200; for oil still parts.

No. 11; C 0.25, Cr 19.0; ts, 100,000 psi; bhn, 200; for valves and chemical apparatus.

No. 12; C 0.10, Cr 12.0, Ni 0.50, ts, 110,000 psi; bhn, 220; for chemical apparatus.

No. 12M; C 0.10, Cr 13.0, Se 0.25; ts, 85,000 psi; bhn, 170; for chemical apparatus.

No. 13; C 0.25, Cr 13.0, Ni 0.50; ts 200,000 psi; bhn, 500; for chemical apparatus and valve trim.

No. 14; C 0.25, Cr 21.0, Cu 1.0, Ni 0.50; ts, 90,000 psi; bhn, 200; for exhaust manifolds, boiler tube hangers.

No. 15; C 0.30, Cr 28.0, Ni 3.0; ts, 60,000 psi; bhn, 190; for heat and corrosion resistant parts.

No. 19; C 0.15, Ni 2.75; ts, 70,000 psi; bhn, 150; for pumps and fittings for sub-zero service.

No. 219; C 0.15, Mn 0.65, Ni 3.25, Mo 0.25; ts, 85,000 psi; bhn, 170; for castings for sub-zero service.

No. 21; C 0.07 max, Cr 19.50, Ni 10.50, Cb 0.80; ts, 80,000 psi; bhn, 145; for stainless and corrosion resistant parts and weldments.

No. 22; C 0.07 max, Cr 19.50, Ni 9.0; ts, 75,000 psi; bhn, 135; for corrosion-resistant chemical and extreme low temperature equipment.

No. 22M; C 0.07 max, Cr 19.5, Ni 9.0, Se 0.25; ts, 80,000 psi; bhn, 160; for free-machining stainless parts.

No. 22XM; C 0.07 max, Cr 19.5, Ni 9.0, Mo 2.5; ts, 82,000 psi; bhn, 170; for highly corrosion resistant parts.

No. 30; C 0.20 max, Cr 24.5, Ni 13.5; ts, 85,000 psi; bhn, 165; for heat and corrosion resistant parts.

No. 30XM; C 0.20 max, Cr 24.5, Ni 13.5, Mo 3; ts, 85,000 psi; bhn, 170; for use as parts for paper mill equipment.

No. 31; C 0.25, Ni 9.0, Cr 28.0; ts, 83,000 psi; bhn, 170; for equipment to resist severe acids and acid fumes.

No. 32; C 0.50, Ni 35.0, Cr 15.0; ts, 70,000; bhn, 150; for heat resistant castings.

No. 33; C 0.07, Cr 19.5, Ni 23.5, also molybdenum, copper and silicon; ts, 72,000 psi; bhn, 150; for castings for sulphuric acid service.

No. 34; C 0.07 max, Cr 20.0, Ni 30.0, also molybdenum, copper and silicon; ts, 72,000 psi; bhn, 150; for parts resistant to H_2SO_4.

No. 41; C 0.50, Cr 17.0, Ni 66.5; ts, 75,000 psi; bhn, 160; for heat resistant parts.

No. 46; C 0.20, Cr 25.0, Ni 20.0; ts, 70,000 psi; bhn, 130; for heat resistant parts.

CLEARSEAL (Vinyl resin coating)—Cleveland Laboratories & Mfg. Co. Inc., Peapack, N. J.

Vinyl resin applied to fabric and paper, also other synthetic rubbers and covers; both thermosetting and thermoplastic, in sheet and laminated form; for molding, sewing and cementing. Abrasion resistance, high (for fabric); resists corrosion caused by acids, alkalis, salts and gasoline; max cont serv temp 250 F; flexibility, high (or changed as desired); moisture absorption, may be varied as required; available in any color. For machine covers, diaphragms, bellows, oil or grease retaining jackets, etc.

CLETALOY (Spot welding electrodes)—Cleveland Tungsten Inc., Cleveland.

Copper-tungsten type electrodes for spot welding. Available in four grades with high specific gravity.

CT-A; predominantly tungsten; hardness of 92-97 Rockwell B with an electrical conductivity about 38 per cent that of pure copper. In addition to spot welding, it works well as crimper die insert for finish turning edge of steel jacket to form a seal for the porcelain stem in spark plugs.

CT-65; conductivity and tungsten similar to that of CT-A grade; hardness of 84-91 Rockwell B. For welding of thin stainless steel sheets, and in the upsetting of special steel which does not forge well, this grade supplies red hot surface which can withstand high pressure of small bar during knob forming process. This grade holds original hardness especially well.

CT-86; has a higher electrical conductivity than other grades with a Rockwell B hardness of 77-83. Suitable for welding nonferrous metals and for applications where low pressures are sufficient.

LN-14; silver-tungsten-base alloy for use in applications where it shows an advantage over copper, possibly having some connection with the fact that silver oxide which might form on surface is a better electrical conductor than copper oxide.

CLEVE-TUNG (Molybdenum)—Cleveland Tungsten Inc., Cleveland.

Mo 99.9 plus. Furnished in rough bars or billets, finished rods and bars, wire, sheet, plate, and powder metal. In cold-worked state; ts, from 50,000 to 250,000 psi; nonmagnetic; weldability, fair; abrasion resistance, medium; max cont serv temp, 3000 F (protected atmosphere). For various electronic parts, etc.

CLEVE-TUNGSTEN (Tungsten) — Cleveland Tungsten Inc., Cleveland, O.

Tungsten rough bars or billets, finished rods and bars, wire, sheet, plate, and powder metal. For power tube parts. Hardness, Rockwell C, 40-80; sp gr, 19.3; nonmagnetic; weldability, poor; resists acids and alkalies; max cont serv temp (protected atmosphere), 4500 F; abrasion resistance, high.

CLIDERITE (Thermoplastic potting material)—Ernst Bischoff Co. Inc., Plastics Div., Ivoryton, Conn.

A waxy plastic material meltable at temperatures above 300 F. Available in Types 1 and 2A. Sp gr (solid, 77F), 0.97; ts, 650-1050 psi; elong at breakpoint, 4-10%; resists dilute acids and alkalies in general. Resists concentrated alkalies and some concentrated mineral acids. Readily attacked by concentrated organic acids and nitric acid. Used for sealing or insulating electrical connectors, rectifiers, batteries, etc.

COAST METALS (Hard-facing rods) — Coast Metals, Inc., Canton, Ohio.

No. 101 (No. 1 gas); tough, file-hard. Good wear and abrasion resistance. High impact, nonmagnetic. Used on brick and clay machinery, agriculture and agriculture processing equipment, steel mill applications (cold).

No. 104 (No. 4 gas); dense rod, highly resistant to abrasion. Acetylene deposits on cylindrical sections without checks. Magnetic. Rockwell C hardness, single layer, 55-60. For shafting, centerless grinder rests, cams, gauge blocks.

No. 112; hard, tough. Harder than No. 101. Rockwell C 52-57. Outstanding resistance to abrasion. Non-magnetic. For digger teeth, jaw crushers, bucket lips, cement mill machinery, hammer mills, excavating equipment, sand shot blast equipment.

No 118 (No. 18 gas); high temperature properties. Withstands constant and repeated loads at high temperature. Machinable with carbide tools. Slightly magnetic. For steam valves, hot dies, punches, pump sleeves, soaking pit tong bits.

No. 107 (No. 7 gas); soft and tough. Nonmagnetic. Limited use, including chip crusher hammers and certain other types of hammer mills.

No. 108 (No. 8 gas); excellent welding properties. Can be heat treated safely. Machinable with carbide tools. Slightly magnetic. For cold trimmers, stampings and punching. Paper, stripper and tin shredding knives. Flash trimmer knives.

No. 109 (No. 9 gas); free from large carbides. Magnetic. Rockwell, single layer, 45-50. For hot piercing mill shoes and high speed or finishing steel mill guides.

No. 110 (No. 10 gas); hard. Moderate high temperature properties. Nonmagnetic. Rockwell C, single layer, 48-56. Large steel mill guides, hot slag handling, coke plant equipment and stripper tong bits.

No. 115 (No. 15 gas); hard, tough, excellent welding characteristics and high temperature properties. Rockwell C, single layer, 53-58. Slightly magnetic. For sprocket teeth on elevators operating at high temperature. Valve ends and cams; mixer rolls.

No. 100X (No. X gas); forgeable, tough, magnetic. Specially developed for hot shears.

COHRLASTIC (Silicone elastomer on fiberglas)—The Connecticut Hard Rubber Co., New Haven, Conn.

Furnished in sheet and strip. Abrasion resistance, medium; chemical resistance, good except for aromatics and concentrated acids and alkalies; max cont serv temp. —70 to 300-500 F; flammable at 1000-1500 F; flexibility, high; dielectric str, 550-1100 volts per mil; moisture absorption, low; available in white, opaque; shatterproof. For resilient gaskets and tapes when heat resistance and/or high dielectric strength over the entire temperature range are required.

COLMONOY (Hard facing welding rod)—Wall-Colmonoy Corp., Detroit 3.

No. 1: Cr 7-11, B 1-2, Si 2-4 and Fe balance. Welding electrode with Rockwell C hardness of 58-62; sp gr, 7.70; weldability, fair. For hard-facing various parts of high manganese steel such as dipper teeth, scraper blades, etc., agricultural equipment.

No. 4: Ni 75-85, Cr 8-14, B, Fe, Si and C 8 max. Cast welding rod; hardness, Rockwell C, 35-40; sp gr, 8.22; nonmagnetic; weldability, good; resists corrosion caused by all alkalies and acids except hydrochloric; max cont serv temp, 1500 F; abrasion resistance, medium.

No. 5: Ni 71-81, Cr 10-17, B, Fe, Si and C 9 max. Cast welding rod; hardness, Rockwell C, 45-50; sp gr, 8.14; nonmagnetic; weldability, good; resists corrosion caused by all alkalies and acids except hydrochloric; max cont serv temp, 1500 F; abrasion resistance, high. For parts subject to wear and corrosion, but which must be hard-faced with a machinable alloy, such as sleeves, auto and diesel valves, steam valves, pump sleeves, pump plungers, etc.

No. 6: Ni 71-81, Cr 10-17, and B, Fe, Si and C 9 max. Cast welding rod (powder metal or plastic rod). Hardness, Rockwell C, 56-62; sp gr, 7.80; nonmagnetic; weldability, excellent; resists corrosion caused by all alkalies and acids except hydrochloric; max cont serv temp, 1500 F; abrasion resistance, high. For shaft sleeves and plungers, steam valve trim, centers, centerless grinder rests, cams, gages, sprockets, seal rings, etc.

No. WCR 100: Cr 13-19, B 2.75-4, W 17-22, and Fe balance. Furnished in finished rods or bars for gas welding. Hardness, Rockwell C, 65-68; sp gr, 8.40; nonmagnetic; weldability, good; abrasion resistance, high.

Sweat-on Paste: for gas welding and carbon arcing. Parts hard-faced with paste may be heat-treated without harm to overlay. Hardness, Rockwell C, 68-72; sp gr, 3.30; abrasion resistance, high. For tractor grousers and sprockets, coal chutes, fan blades, sand scraper blades and other foundry equipment subject to severe wear such as dipper teeth, bucket lips, etc.

COLONIAL (Alloy tool steels)—Vanadium-Alloys Steel Co., Anchor Drawn Steel Co., Colonial Steel Div., Latrobe, Pa.

Two types, both available in rough bars or billets, finished rods or bars, wire, sheet, plate, forgings and drill rods.

No. 14; C 1.00, Si 0.25, Mn 0.25. In heat-treated state: hardness, Rockwell C, 65-67; abrasion resistance, low.

No. 7; C 1.00, Si 0.25, Mn 0.25, and V 0.20. In heat-treated state: Hardness, Rockwell C, 65-67; max cont serv temp, 300-500 F; abrasion resistance, medium; good bearing qualities.

COLONIAL (Ceramics)—The Colonial Insulator Co., Akron, O.

Ceramic base material for molding, casting, stamping and extruding. Has high abrasion resistance; resists corrosion caused by most acids and alkalies; max cont serv temp, 750 F; moisture absorption, low; available in colors, opaque; machinability, poor. For electrical control parts, thread guides, etc.

COLORSTRIP (Colored strip steel)—Acme Steel Co., Chicago 8, Ill.

Strip steel, electro-galvanized or plain and coated on one or both sides with any specific color (coating may be either enamel or lacquer); furnished in coils and can be fabricated by rolling or stamping; corrosion-resistant; resists heat to 150 F; same tensile strength, elongation and hardness as standard strip steel with slight variations depending on temper and analysis of the base metal.

COLUMBIA (High tensile steel)—Columbia Steel & Shafting Co., Pittsburgh 30.

Furnished in bars. Tensile strength is high; bearing properties, good; material machines freely.

COMMERCIAL (Steel castings) — Commercial Steel Casting Co., Marion, O.

Steel castings to special specifications and to ASTM, Army or Navy, American Bureau of Shipping and Maritime Commission Specifications.

COMMONWEALTH (Steel castings) — General Steel Castings Corp., Granite City, Ill.

Produced to specifications of ASTM, AAR, Federal, Bureau of Shipping, Navy, etc. Also carbon low and medium alloy steel castings to proprietary specifications. For railroad devices, heavy industrial machinery, pumps, etc.

COMPAC (Shellac-base plastics)—Poinsettia Co. Inc., Pitman, N. J.

Thermoplastic; furnished in powder, granules and preforms for compression molding. Available in black, red, green, blue and yellow. Moisture absorption, medium; is opaque; machinability, poor. Has excellent molding properties.

COMPAR (Thermoplastic elastomer)—Resistoflex Corp., Belleville, N. J.

Compounded, modified polyvinyl alcohol base material; furnished in sheets, rods and tubes and hose. Solvent and abrasion resistance, high; heat resistant to 250 F; flexibility, high; ts, 2500-5200 psi; moisture absorption, medium; sp gr, 1.26; hardness, 65-100. For flexibile hose connections and assemblies for low and medium pressure hydraulic systems, lubricating, refrigeration, air conditioning and fuel systems. Gaskets, diaphragms and molded parts.

COMPO (Porous bronze)—Bound Brook Oil-Less Bearing Co., Bound Brook, N. J.

H: Oil-retaining porous bronze bearings; Cu 80, Sn 9.75, graphite 1.25. Furnished in completed parts via powder metallurgy. Impregnated with 23% of lubricant by volume. Ts, 14,700 psi; hardness, 30-70 Rockwell H. For oil-less bearings in machines.

3H: Oil-retaining porous bronze bearings; Cu 89, Sn 9.75, graphite 1.25. Furnished in completed powder metal parts. Impregnated with 27% of lubricant by volume. Ts, 12,000 psi; hardness, 25-50 Rockwell H. For oil-less bearings in all types of machines.

R: Porous bronze bearings and washers containing higher percentage of graphite; Cu 87, Sn 9.5, graphite 3.5. Porous structure contains to 15% oil developed particularly for antiscuffing under heavy vibrating static loads; also heavy oscillating loads. Ts, 15,000 psi; comp str, 75,000 psi.

F: Oil retaining porous bronze bearings; Cu 85, Sn 9.5, graphite 5.5. Furnished in completed powder metal parts. For seals, seal rings, seal thrust washers in pumps, compressors, etc.

CONDULOY (Beryllium copper)—The Brush Beryllium Co., Cleveland.

Be 0.35, Ni 1.5, Cu balance. Furnished in form of rough bars or billets. Heat-treated: Ts, 85-100,000 psi; ys, 70-80,000 psi; elong in 2 in., 4-13%; hardness, 90-100 Rockwell B; nonmagnetic; weldability, fair; max cont serv temp, 700-800 F; resists corrosion about same as pure copper. For resistance welding electrodes, welding wheels, circuit breakers, etc., and brake drums.

Beryllium Copper Alloy No. 6; Be 2.5, Ni 1.1, Cu balance. Furnished in form of rough bars or billets. Heat treated; Ts, 150-180,000 psi; ys, 110-140,00 psi; elong in 2 in., 1-3%; hardness, 38-44 Rockwell C; nonmagnetic; weldability, fair; abrasion resistance, high; resists corrosion about same as pure copper; max cont serv temp, 400-500 F. For bearings, bushings, and high-strength, high-hardness parts in general.

CONGO (High speed tool steel)—Braeburn Alloy Steel Corp., Braeburn, Pa.

Tool steel containing C 0.78, Cr 4.00, W 4.00, Mo 5.00, Co 12.00, V 1.40. Furnished in rough bars or billets, finished rods or bars, and fabricated into parts by machining. Recommended heat-treatment; 2180 F, oil quench; 1050 F draw. Heat-treated, hardness, Rockwell C 64-66; has high abrasion resistance. For various cutting and forming tools.

CONPERNIK (Iron-nickel magnetic alloy)—Westinghouse Electric Corp., East Pittsburgh, Pa.

Ni 49.5, Fe 49.5 and Mn .01. Has constant permeability over limited ranges of flux variations; available in punchings and finished cores, continuous cold-rolled strip and hot-rolled sheets. Makes possible choke coils having a high ratio of inductive resistance components.

CONSERVO (Rubber) — Hewitt Rubber Div., Hewitt-Robins Inc., Buffalo 5.

Rubber for hose, belting and packing. Can be furnished extruded or for molding. Abrasion resistance, high. For use wherever hose belting or packing are required.

CONSOWELD (Thermosetting laminated plastics)—Consolidated Water Power & Paper Co., Wisconsin Rapids, Wis.

Melamine formaldehyde and phenol formaldehyde base; in laminated sheet form; max cont serv temp, 250 F; dielectric strength (volts per mil inst), 550 (⅛ in. thick); ts, 36,000 psi; produced in fawn, gray, blue, green, ivory, linen patterns, black. Moisture absorption, low; sp gr, 1.35-1.40; opaque; machinability, good; bhn, 34; coefficient of thermal expansion, 2.0 x 10^{-5} inch/inch/degree C. Used for nameplates, die plates, bearings, decorative covering for working areas on benches.

CONTINENTAL (Alloy steels) — Continental Foundry & Machine Co., East Chicago, Ind.

C-1; furnished in seven grades ranging from 0.20-0.80 carbon content; plain carbon steels.

C-2; C-Mn-Ni-Mo cast steel for parts requiring special physical properties such as tractor frames, locomotive castings, power shovel castings, locomotive crane castings, and other machinery parts.

C-3; C-Mn-Mo cast steel requiring special properties such as sprockets, spindles, gears, miscellaneous castings for power shovels, locomotive cranes, locomotive wheel centers and crossheads, and other parts.

C-4; C-Mn-Mo-V cast steel for pinions, axles and spindles, and other parts subject to severe service.

C-5; C-Ni-Mo cast steel for forging machinery and hammer parts, rams and sow blocks.

C-6; C-high Cr-Mo cast steel for special abrasive qualities suitable for various types mills, crushers, etc.

C-7; C-Cr-Ni-Mo cast steel designed for machinery or other parts subjected to severe wear, strength and impact service.

C-10; C-Cr-Mo cast steel for forging dies, tools, etc. All of the above steels are heat-treated to give desired properties.

"Chrome-Molybdenum"; Cr-Mo alloyed steel rolling mill rolls for blooming, bar, billet, structural and merchant mills, also backing-up rolls for strip mills.

"Heat-Treated Alloy"; Cr-Ni-Mo rolling mill rolls for billet, blooming, merchant and bar mills.

Special; Ni-Cr alloyed steel for rolling mill rolls for use in billet, bar, structural and merchant mills where resistance to wear is prime factor.

COOPER ALLOYS (Metal alloy castings)—The Cooper Alloy Foundry Co., Hillside, N. J.

Stainless steels, pure nickel and Monel castings to specifications. Used primarily for combatting corrosion, heat and abrasion.

COPEL (Electrical resistance alloy) — Hoskins Mfg. Co., Detroit 8.

Used mostly for electrical resistance purposes, also for heating elements to 800 F. Temperature coefficient of resistance is practically nil.

COPPERWELD (Copper-covered steel)—Copperweld Steel Co., Glassport, Pa.

Copper-covered steel in wire, strand, or rods, with copper exterior permanently welded (cast) to the steel core; resists rust and corrosion; provides adequate electrical conductivity for many electrical uses and rust-resisting high strength for many mechanical uses.

CORDIERITE (Ceramics)—General Ceramics & Steatite Corp., Keasbey, N. J.

Furnished in sheet, rods or tubes, and plates. Abrasion resistance, low; resists acids and weak alkalies, except hydrofluoric acid. Max cont serv temp, 2200 F; nonflammable; transverse str, 8500 psi; moisture absorption, low; sp gr, 2.38; available in light tan, opaque. For use where high heat shock resistant ceramic material is required.

CORNING (Glasses) — Corning Glass Works, Corning, N. Y.

In general, glasses with coefficient of expansion above 50 x 10^{-7}/°C. Blown, drawn, pressed products with wide range of chemical, physical, optical, electrical and mechanical properties.

CO-RO-LITE (Phenolic base resin)—Columbian Rope Co., Auburn, N. Y.

Phenolic base resin material, furnished in sheet form for molding into parts. Abrasion resistance, high; heat resistant to 350 F; flexibility, medium; ts, 11,000 psi; inflammable; can be highly polished; opaque; can be produced in color. Used for cams, gears, bobbin heads, bearings, tension and compression members, etc.

CR-39 (Thermosetting plastics)—The Homalite Corp., Wilmington 166, Del.

Furnished in sheet form. Abrasion resistance, very high; chemical resistance, excellent; max cont serv temp, over 300 F; is slow burning; has medium flexibility; dielectric str, 523 volts per mil, inst; ts, 6000 psi; comp str, 22,000 psi; flexural str, 8000-10,000 psi at 25 C; elongation and compression set, low; moisture absorption, low; produced in clear sheet only; not shatterproof; hardness, Rockwell M 100; coef of thermal expansion, low. Used for aircraft windows, bus and truck panels, etc.

CRASFLOY (Hard iron alloy) — Continental Foundry & Machine Co., East Chicago, Ind. and Pittsburgh, Pa.

Hard alloy grain iron rolling mill rolls made in four grades: mild, medium, hard and super hard for rolling hot and cold strip, sheets and plate.

CRESCENT (Solder)—Crescent Smelting Works, Inc., Brooklyn 6, N. Y.

Furnished in bars, strips and wire for soldering lead, brass, copper, black and galvanized sheet metal and stainless steels.

CROLITE (Steatite and other ceramics)—Henry L. Crowley & Co., West Orange, N. J.

Steatite and other ceramics, suitable mainly as electrical insulation and particularly the critical insulation for high-frequency radio applications.

CROMANSIL (Arc welding electrode)—Metal & Thermit Corp., New York 5.

For main drive shafts, automotive springs, jib crane parts, etc. Weld deposit: Ts, 77-114,000 psi; ys, 65-102,000 psi; elong in 2 in., 14-26%.

Type E-43; arc welding electrode for aluminum sheet, castings, shapes or extruded forms, Min ts, 14,000 psi; chemical analysis, Al 92.5-94, Si 4.5 to 6.

Type FHP: For machine frames and bases, diesel exhaust manifolds, hoists and other heavy weldments. Weld deposit: Ts, 62-70,000 psi; ys, 52-58,000 psi; elong in 2 in., 25-31%.

CROMONITE (Hard iron alloy) — Continental Foundry & Machine Co., East Chicago, Ind. and Pittsburgh, Pa.

Hard alloy chill roll made in four grades: Mild, medium, hard and super hard for hot and cold strip rolling.

CROWLEY (Powder metal)—Henry L. Crowley & Co., West Orange, N. J.

Powder metal in parts such as bearings, filters, formed pieces, etc.

CUMBERLAND (Turned and ground mild steels)—Cumberland Steel Co., Cumberland, Md.

Turned and ground steel rods made to AISI spec's. C 1022, C 1040 and C 1141. For precision shafting, studs, tie rods, etc.

CUNICO (Permanent-magnet alloy) — General Electric Co., Chemical Dept., Pittsfield, Mass.

Alloy of copper, nickel and cobalt, made from rod, strip or wire stock, furnished in finished shapes, age-hardened. Malleable, ductile and machinable, permitting manufacture of small magnet screws and punching of intricate shapes.

CUNIFE (Permanent-magnet copper-nickel-iron alloy) — General Electric Co., Chemical Dept., Pittsfield, Mass.

Magnets made of wire stock in round, square or rectangular form. Wire can be flattened to make thin, narrow shapes. Wide variety of magnet designs can be obtained by forming, drawing, punching, or machining.

CUPALOY (Copper-base alloy)—Westinghouse Electric Corp., East Pittsburgh, Pa.

Copper-base alloy containing chromium and silver; thermal and electrical conductivity, 80-85% of pure copper with tensile strengths of 40,000-50,000 psi for castings and 60,000-80,000 psi for wrought bar. Applications include spot-welding tips, seam-welding disks and parts requiring high conductivity with mechanical strength appreciably superior to copper.

CUPRO-ARC (Welding electrodes)—Alloy Rods Co., York, Pa.

Electrodes for welding brass, bronze and copper.

CUPRODIE (Alloy steel)—A. Finkl & Sons Co., Chicago, Ill.

A 0.50 carbon, Cr-Ni-Mo-Cu steel for die blocks, inserts, and bars; furnished heat-treated to various tempers, all commercially

machinable to 477 bhn. For drop hammer dies and inserts, also forging machine dies.

CUPRON (Copper-nickel alloys) — Wilbur B. Driver Co., Newark, N. J.

Cu 55, Ni 45; in rough bars or billets, finished rods or bars, wire and coiled strips. In untreated state, ts, 62,000 psi; elong. hard, 2%; soft 40%; sp gr, 8.9; nonmagnetic; weldability, good; heat-resistant to 1500 F. For electrical uses.

CUTRODE (Cutting electrode)—Eutectic Welding Alloys Corp., New York 13.

Furnished in coated rods for cutting all metals such as cast iron, stainless steels, aluminum bronzes, etc., without the use of special equipment and without oxygen. Used in ordinary electrode holder; also for use in underwater cutting.

D

DAIRYWHITE (Copper-nickel alloy) — Arthur Harris & Co., Chicago 7.

Cu 67, Ni 23, balance zinc, lead and tin. For food machines, dairy machines, etc.

DAREX (Sealing compound)—Dewey & Almy Chemical Co., Cambridge 40, Mass.

Dispersions of rubber or synthetic resins which when deposited in a closure dry to form a gasket that becomes an integral part of the metal part. Supplied in fluid form; flowed into joint. Recommended for seals on all types of closures or for cushioning vibration.

DEFENDER (Babbitt) — Magnolia Metal Co., Elizabeth, N. J.

Lead-base, less than 10% of tin; recommended for shock loads; bhn, 21.8.

DENSEWOOD (Wood-base thermoplastic) — Densewood Corp., Elkhorn, Wis.

A wood-base, thermoplastic material to be machined into parts. Abrasion resistance, medium; heat-resistant to 350 F; flexibility, low; ts, 18,000 psi; comp str, 14,400 psi; moisture absorption, low; noninflammable; sp gr, 1.15; opaque; can be highly polished. Used for pulleys, rollers, pushbuttons, etc.

DENS-TECH (Plywood)—Technical Ply-Woods, Chicago 1.

Thermosetting; furnished in sheet form for machining into parts; abrasion resistance, good; resists corrosion, repels termites; heat resistance, good; bonded at 350 F; flexibility, medium to low depending on thickness; tensile and compressive strengths, good to excellent depending on thickness; moisture resistance, excellent; machinability, good.

DEWARD (Oil-hardening tool steel)—Allegheny Ludlum Steel Corp., Brackenridge, Pa.

A general-purpose oil-hardening tool steel. Suitable for intricate machine parts subject to wear without much shock. Hardens with very little size change. Available in hot-rolled, annealed bar stock, forged disks and rings, cold drawn or ground bars. Wide range of sizes carried in warehouse stocks.

DIAMITE (White iron castings) —, Weatherly Foundry & Mfg. Co., Weatherly, Pa.

Low-silicon cast iron containing 4½% nickel and 1½% chromium. Furnished in the form of sand castings to specification; ts, 40,000 psi; Bhn, 600-700; weldability, fair; abrasion resistance, high. For sand pumps, cement mill parts, grinding wheel molds and abrasion resistant castings.

DIAMOND (Vulcanized fiber) — Continental-Diamond Fibre Co., Newark 23, Del.

Cellulose hydrate material, furnished in laminated sheets, rods, tubes and formed parts. Abrasion resistance, high; gasoline, kerosene, oil, grease and alcohol resistant; max cont serv temp, 220 F; flexural str, 13,000 psi (ASTM D-229-42); dielectric str, 150 volts per mil; ts, 8000 psi; comp str, 30,000 psi; impact str, 5.5-8.0 ft-lb (Izod); produced in gray, white, black and red; moisture absorption, medium; sp gr, 1.1-1.4; opaque; bhn 15. For electrical insulation, gaskets, water seals, bobbins, handles, housings and gears.

DIE-TECH (Plywood) — Technical Ply-Woods, Chicago 1.

Thermosetting; furnished in sheet form for machining into parts; abrasion resistance, good; resists corrosion, repels termites; heat resistance good; bonded at 350 F; flexibility, medium to low depending on thickness; tensile and compressive strengths, good to excellent depending on thickness; moisture resistance depends on treatment; machinability, excellent.

DIEWELD (Welding rod)—American Manganese Steel Div., American Brake Shoe Co., Chicago Heights, Ill.

C-Cr-Mo: For hard facing only; bhn, 500-600; martensitic steel deposits, magnetic; high abrasion and impact resistance, air hardening, responds to heat treatment, can be forged. For production of composite dies, shear knives, milling cutters, reamers, simple dies and molds, etc. For reclamation of worn shear knives, punches, and molds; upset and drop forging dies and tools. For general hard facing.

DILECTO (Glass fabric)—Continental-Diamond Fibre Co., Newark 23, Del.

Phenol formaldehyde thermosetting material; furnished in sheets, rods and tubes for compression molding. Abrasion resistance, high; gasoline, kerosene, oil, grease, alcohol, acid and weak alkali-resistant. Max cont serv temp, 350 F; flexural str, 21,000 psi (ASTM D-229-42); dielectric str, 600 volts per mil; ts, 24,000 psi; comp str, 44,000 psi; impact str, 10.0 ft-lb (Izod); produced in natural color; moisture absorption, low; sp gr, 1.6; opaque. For electrical insulation.

DILECTO (Thermosetting plastics)—Continental-Diamond Fibre Co., Newark, 23, Del.

Phenolic base, thermosetting; furnished in sheets, rods and tubes for compression molding; also available in post formed parts. Abrasion resistance, high; resistant to gasoline, kerosene, oil, grease, alcohol, acids and weak alkalies. Max cont serv temp, 250 F; flexural str, 19,000 psi (ASTM D-229-42); dielectric str, 700 volts per mil; moisture absorption, low; ts, 12,000 psi; available in tan and black; impact str, 1.1 ft-lb (Izod); takes high polish. Used for cams, bushings, nameplates, baffle plates, thrust washers, valve seats, bobbins, pulleys and spacers.

DM (Steel)—Timken Steel & Tube Div., The Timken Roller Bearing Co., Canton, Ohio.

Carbon 0.15 max, Mn 0.3-0.6, Si 0.5-1, Cr 1-1.5, Mo 0.45-0.65, P 0.03 max, S 0.03 max; furnished in rough bars or billets, finished rods or bars and tubing; for hot forging, welding, turning, boring, etc., into parts. Resists heat to 1100 F; ts, 60,000 psi min; medium ductility; fair weldability; and Bhn, annealed, 163 max. Used in oil refinery field.

DM-45 (Alloy steel)—Timken Steel & Tube Div., The Timken Roller Bearing Co., Canton, Ohio.

Carbon .4-.5, manganese .4-.7, silicon .5-.8, chromium 1-1.5, molybdenum .45-.65; furnished in rough bars or billets, and finished rods or bars; for hot forging, turning, boring, etc., into parts. Resists heat to 1100 deg F; ts, 150,000 psi, min, heat-treated; medium ductility; Bhn, untreated, 185; heat-treated, 411 max. For bolts, studs and other highly-stressed parts used at elevated temperatures.

DODGE (Composition cork)—Dodge Cork Co. Inc., Lancaster, Pa.

Furnished in sheet, strip, rods or tubes, plate and special shapes. Fabricated by die cutting, turning and sawing. Abrasion resistance, medium; noninflammable; flexibility, high; moisture absorption, medium; used for gaskets, washers, bumpers, vibration dampers, friction drives, inserts, plugs and floats.

DODGE (Steel castings) — Dodge Steel Co., Tacony, Philadelphia.

Medium-Carbon Steel (SAE 1030); furnished in heat-treated sand castings. Ts, 70,000 psi; ys, 35,000 psi; elong in 2 in., 24 per cent; bhn, 143 min; magnetic; weldability, good; abrasion resistance, medium; max cont serv temp, 850 F. For machine parts subject to moderately high loads and impact; valves and fittings for steam, liquids and various gases; structural members, etc.

D-1 Manganese-Molybdenum Steel; furnished in heat-treated sand castings. Ts, 80-170,000 psi; ys, 55-140,000 psi; elong in 2 in., 22-7.5 per cent; bhn, 163-360; magnetic; weldability, fair (good when preheated); abrasion resistance, good (when fully hardened). For high-strength machine parts and those requiring wear resistance, and flame or induction hardening.

D-12 Low Carbon-Nickel Steel; furnished in heat treated castings. Ts, 70,000 psi; ys, 40,000 psi; bhn, 143; magnetic; weldability, good; abrasion resistance, medium; excellent low-temperature properties (15 ft-lb Charpy at 75 F). For structural and machine parts subject to impact load, at normal and low temperatures.

DOLER ALSILOY #1 (Aluminum die-casting alloy)—Doehler-Jarvis Corp., New York 16.

Alloy contains 12% silicon. Ts, 40,000 psi; ys, 20,000 psi; elong in 2 in., 3%; Charpy impact, 3 ft-lb; Bhn, 75; sp gr, 2.66; nonmagnetic; resists atmospheric corrosion; max cont serv temp, 500 F; abrasion resistance, low. For general industrial parts such as for household utilities industries, optical, electrical, food containers, business machines, tools, etc.

DOLER ALSILOY #9 (Aluminum-base die-casting alloy)—Doehler-Jarvis Corp., New York 16.

Alloy containing Cu 3.5, Si 9, balance, Al. Ts, 40,000 psi; ys, 25,000 psi; elong in 2 in., 2.5%; Charpy impact, 3 ft-lb; Bhn, 80; sp gr, 2.80; nonmagnetic; weldability, fair; resists atmospheric corrosion; max cont serv temp, 500 F; abrasion resistance, low. For electrical items, household utilities, food containers.

DOLER ALSILOY #10 (Aluminum-base die-casting alloy) — Doehler-Jarvis Corp., New York 16.

Alloy containing Si 10, Mg 0.5, balance Al. Ts, 45,000 psi; ys, 27,000 psi; elong in 2 in., 4.5%; charpy impact, 5 ft-lb; Bhn, 75; sp gr, 2.66; nonmagnetic; weldability, fair; resists atmospheric corrosion; max cont serv temp, 500 F; abrasion resistance, low. For die-cast machine parts requiring good tensile strength, high corrosion resistance and good electrical properties.

DOLER-BRASS (Brass die castings)—Doehler Jarvis Corp., New York 16.

Brass die castings. Composition suited to meet varying conditions. Ts, to 100,000 psi, and Bhn, to 180; excellent corrosion resisting properties.

DOLER-MAG (Magnesium-base die castings)—Doehler Jarvis Corp., New York 16.

Die castings to specification which are one-third lighter than aluminum.

DOLER-ZINK (Zinc-base die castings)—Doehler Jarvis Corp., New York 16.

Zinc base die castings of maximum tensile and impact strength.

DO-LITE (Aluminum-base die castings)—Doehler Jarvis Corp., New York 16.

Composition suited to meet stringent requirements such as high tensile strength, impact strength, hardness, corrosion resistance, thermal conductivity and electrical conductivity.

DOW CORNING (Silicone fluids and greases)—Dow Corning Corp., Midland, Mich.

DC 702 and DC 703 (Silicone fluid); boiling point 750 to 840 F; flash point, 390 to 490 F; moisture absorption, low; sp gr, 1.07 to 1.09; for high vacuum diffusion pump fluids. Stable to air and moisture at operat-

ing temperatures of 175 to 225 C. Produce vacuums as high or higher than conventional organic pump fluid.

DC 200 (Silicone fluid); is chemically inert; minimum flash point, 600 F; is water repellent; sp gr, 0.76-0.97. Shows less change in viscosity with temperature than any other known fluid; low volatility, negligible vapor pressure, high oxidation resistance. For damping, hydraulic, and instrument fluids, liquid dielectrics; mold release agents; waterproof treatments.

DC 4 (Silicone compound); max cont serv temp, 390 F; flash point, over 400 F; dielectric strength (volts per mil inst), greater than 500; water repellent; for waterproof seals and auxiliary dielectrics in high tension ignition systems and in disconnectable junctions of high-frequency communications equipment. Also lubricates and protects rubber and synthetic insulation from electrical leakages due to moisture and from deterioration due to thermal oxidation or corona cutting.

DC 550 (Silicone lubricating oil): Fluid lubricant applied with an oil can or by dipping. Cont serv temp, from —40 to 500 F. Chemical resistance, good; flash point, 600 F; low moisture absorption; sp gr, 1.08; color, pale yellow; transparent; coef of thermal expansion, 7.5 x 10^{-4} C. For high-temperature baths, oven machinery and timers.

DC 710 (Silicone lubricating oil): Silicone fluid lubricant applied with oil can or used to impregnate porous bearings. Cont serv temp, from 10 to 500 F. Chemical resistance, good; sp gr, 1.10; low moisture absorption; transparent; excellent lubricant on light loads; coef of thermal expansion, 4.0 x 10^{-4} C. For conveyors, oven timers, hydraulic fluid, etc.

DC 44 (Silicone greases); cont serv temp, —40 to 350 F; moisture absorption, low; worked penetrometer, 235-265. Are semi-inorganic oxidation resistant greases; do not form gums or sludges; low volatility; minimum bleeding. For packing permanently sealed antifriction bearings especially in motors. Lubrication of high speed antifriction bearings at elevated temperatures.

DC 41 (Silicone greases); cont serv temp, —40 to 400 F (less than 4000 rpm); moisture absorption, low; worked penetrometer, 280-315; are semi-inorganic oxidation resistant greases, do not form gums or sludges, low volatility; minimum bleeding. For lubricating oven machinery, pumps handling hot salts and for low-speed equipment operating at high temperatures.

DC 33 (Silicone greases); cont serv temp, —95 to 300 F; worked penetrometer, 280-315. These are semi-inorganic oxidation resistant greases, do not form gums or sludges; low volatility; minimum bleeding. For lubrication of antifriction bearings exposed to extremely low and high-temperature operation at speeds up to 20,000 rpm.

DC Valve Seal A (Silicone valve lubricant): Nonmelting grease, applied with grease gun to valve fittings. Chemical resistance, high; cont serv temp, —40 to 500 F; flash point, 600 F; moisture absorption, low; translucent; noncorrosive. For pressure lubricated valves and flow meter bearings exposed to high temperatures and a wide variety of chemicals.

DOW CORNING DC 993 and DC 996 (Electrical insulation)—Dow Corning Corp., Midland, Mich.

For bonding, dipping and vacuum impregnating. Abrasion resistance, medium; good resistance to dilute acids, concentrated hydrochloric, dilute and concentrated alkalies, mineral oil and salt solutions. Max cont serv temp, 400 F; flexibility, high; dielectric str, 2500-3000 volts per mil; moisture absorption, low; available in brown; shatterproof; sp gr, 1.01-1.02; opaque. For impregnating motors, transformer coils and solenoid coils insulated with inorganic materials.

DOW CORNING (Silicone resin)—Dow Corning Corp., Midland, Mich.

DC 2103: For bonding rigid inorganic laminates; furnished in fluid state. Abrasion resistance, medium; chemical resistance, excellent; max cont serv temp, 400 F; slow burning; dielectric str, 250 volts per mil; arc resistance, 260 sec; ts, 14-17,000 psi; comp str, 34-36,000 psi; transverse str, 9-11,000 psi (tensile crosswise); flexural str, 20-30,000 psi; moisture absorption, low; produced in straw color; opaque. Has high resistance to tracking. For electric panel board, transformer tubes and electrical parts.

DOWMETAL (Magnesium alloys) — The Dow Chemical Co., Midland, Mich.

Magnesium alloy ingots, castings, wrought forms, rods, bars, sheets, shapes, extrusions, sand and die castings; also magnesium metal ingots, and magnesium metal sticks. Available in various types:

C; Al 9, Mn 0.1, Zn 2, remainder Mg; in ingots for sand castings. Ts, 40,000 psi; comp str, 60,000 psi; ys, 16,000 psi; elong, 10%; impact resistance, high; high elastic resilience; sp gr 1.82; nonmagnetic; resists corrosion caused by caustic chromic acid, hydrofluoric atmospheres, etc. Used for reciprocating parts and housings.

FS-1; Al 3, Mn 0.3, Zn 1, remainder Mg; in rough bars or billets, finished rods or bars, tubing, sheets, coiled strips, plates; for extruding, rolling, drawing and pressing. Ts, 40,000 psi; ys, 30,000 psi; comp str, 50,000 psi; elong, 16%; endurance limit (completely reversed bending), 14,500 psi; sp gr 1.77; nonmagnetic; high elastic resiliency. Used for aircraft parts and other applications requiring light weight.

H; Al 6, Mn 0.2, Zn 3, remainder Mg; in ingots for sand casting. Ts, 40,000 psi; ys, 14,000 psi; comp str, 46,000 psi; elong, 12%; impact resistance, high; high elastic resilience; sp gr, 1.83; resists corrosion caused by caustic, chromic acid, hydrofluoric atmospheres, etc. Used for aircraft parts and other applications requiring light weight.

J-1; Al 6.5, Mn 0.2, Zn 1, remainder Mg; in rough bars or billets, finished rods or bars, tubing, for hot forging, extruding, rolling, drawing and pressing. Ts, 45,000 psi; ys, 32,000 psi; comp str, 69,000 psi; elong, 15%; endurance limit (completely reversed bending), 18,000 psi; sp gr, 1.8; nonmagnetic; high elastic resilience. For structural parts and fabricated housings.

M; Mn 1.5, remainder Mg; in the same form as for sand castings, hot forging, rolling, drawing and pressing. In rolled state; ts, 37,000 psi; ys, 29,000 psi; elong, 8%; impact resistance high; sp gr, 1.76; nonmagnetic; weldability, good; heat-resistant to 400 F; high elastic resiliency. For parts requiring best combination of formability and weldability of magnesium alloys.

O-1; Al 8.5, Mn 0.2, Zn 0.5, remainder Mg; in rough bars or billets, finished rods or bars and tubing; for hot forging and extruding. In heat treated state; ts, 50,000 psi; comp str, 75,000 psi; elong, 5%; impact resistance, high; endurance limit (completely reversed bending), 16,000 psi; sp gr, 1.8; nonmagnetic, high elastic resiliency. For structural parts requiring maximum strength.

R; Al 9, Mn 0.2, Zn 0.6, remainder Mg; in ingots for die casting. Mechanical properties in untreated state; ts, 33,000 psi; ys, 22,000 psi; elong, 3%; impact resistance, high; sp gr, 1.81; abrasion resistance, medium; nonmagnetic. For die cast housings and structural parts.

DUC-TEN (Alloy steel castings)—Electric Steel Castings Co., Speedway, Indianapolis 24, Ind.

Wide variety of alloy steel castings including castings produced to specifications of ASTM, AAR and SAE.

DUFELT (Felt laminated with Neoprene)—The Felters Co., Boston.

Available in any desired combination of thicknesses or lamination arrangements. Corrosion-resistant. Used for washers and strips for oil and grease retention where operating conditions are too severe for use of plain felt. Petroleum-resistant.

DUOLITE (Laminated safety window glass)—Pittsburgh Plate Glass Co., Pittsburgh 19.

Has Vinyl plastics binder; furnished in flat and bent sheets. Corrosion and abrasion resistance, high; heat resistant to 180 F; flexibility, low; moisture absorption, low; nonflammable; shatterproof; transparent; highly polished. For windows which need not be optically perfect.

DUPLATE (Laminated safety plate glass) — Pittsburgh Plate Glass Co., Pittsburgh 19.

Laminated plate glass and vinyl plastics binder, furnished in flat and bent sheets. Corrosion and abrasion resistance high; heat-resistant to 180 F; flexibility, low; moisture absorption, low; noninflammable; shatter-resistant; transparent; highly polished. For shatter-resistant windows, including those of high optical quality.

DURALON (Furane - base plastics) — United States Stoneware Co., Akron 9.

Thermoplastic; for casting, machining, surface coating or laminating; abrasion resistance, high; resists corrosion caused by chemical or solvent action; heat-resistant to 400 F; flexibility, medium; dielectric strength, over 5000 volts per mil; moisture absorption, low; produced in black; shatterproof with certain fillers and in certain shapes; sp gr, 1.1; opaque; machinability, good; hardness, 110 Rockwell M (depending on cure); soluble in nothing after cure, except strong oxidizing acids. For light metal stamping dies, solvent proof coatings, cast electrical insulating parts, etc.

DURALOY (Chromium steel)—The Duraloy Co., Scottdale, Pa.

Alloy CA; Cr 11-14, C 0.15 max. Furnished in sand castings, sheets, plate and centrifugally cast tubes. Fabricated by machining and welding. Used for pump parts such as valves.

Alloy CB; Cr 18-22, C 0.30 max. Furnished in sand castings, sheets, plate, and centrifugally cast tubing. Fabricated by machining, bending and forming, arc welding and gas welding. Max cont serv temp, 1450 F. Used for special valves, impellers, etc., for high temperature service in the chemicals and food processing industries.

Alloy CC; Cr 26-30, Ni 4.00 max, C 0.50 max. Furnished in sand castings, sheets, plate and centrifugally cast tubes. Fabricated by machining and welding. Max cont serv temp, 2100 F. Has high resistance to sulphur atmospheres. Used for high temperature applications.

Alloys H and H2; Cr 17-28, high carbon. Furnished in sand castings. Max cont serv temp, 1450 F; abrasion resistance, high. Used for roll guides, crusher plates, glass molds and plungers, abrasive conveying systems.

Alloy CE; Cr 17-21, Ni 9-13. Furnished in sand castings, sheet, bars, and centrifugally cast tubing. Ts, heat-treated, 75,000 psi; ys, 40,000 psi; elong in 2 in. 50%; weldability, good; max cont serv temp, 1550 F. Used for pump parts, pipe and fittings, autoclaves and digesters, textile specialties, mixing kettles.

Alloy HH; Cr 23-28, Ni 9-13. Furnished in finished rods or bars, sand castings, sheet, plate, centrifugally cast tubing. Fabricated by machining, bending and forming, arc and gas welding. Ts, 70,000 psi; ys, 45,000 psi; elong in 2 in., 15%; max cont serv temp, 2100 F. Used for furnace parts, salt pots, trays for heat-treating, belt conveyors, oil still parts, radiant burner tubes.

Alloy HT; Cr 13-17, Ni 34-37. Furnished in finished rods or bars, tubing, sand castings, sheet, plate, and centrifugally cast tubing. Fabricated by machining, bending and forming, arc and gas welding. Ts, 60,000 psi; ys, 35,000 psi; elong in 2 in., 5%; max cont serv temp, 2100 F. Used for retorts, trays, carburizing equipment, furnace parts, radiant burner assemblies.

Alloy HW; Cr 15-19, Ni 64-68. Furnished in sand castings and centrifugally cast tubing. Used for retorts, muffles, carburizing trays and fixtures, cyanide pots, etc.

DURAMAL (Pearlitic malleable iron)—Webster Mfg. Inc., Tiffin, O.

Furnished in the form of sand castings to specification; ts, 70,000 psi; ys, 50,000 psi; elong in 2 in., 10%; Bhn, 180; weldability, fair; abrasion resistance, medium. For high strength conveyor chain, abrasion resistant conveyor buckets, high strength agricultural castings, etc.

DURASHIELD (Cellulose acetate plastics)—Plastic Fabricators Inc., San Francisco 11.

Thermoplastics; can be fabricated to any size, shape, thickness or color; can be die cut and punched. Abrasion resistance, low; resists corrosion caused by salt spray and moisture; heat-resistant to 170 F; flexibility, high; shatterproof; moisture absorption, low; transparent, translucent and opaque. For nameplates.

DURCO (Cast alloy steels)—Duriron Co., Inc., Dayton, Ohio.

Alloy steels (KA2S, KA2SMo, etc.); 18 Cr, 8 Ni, C max 0.07, and other standards as well as special analyses preferred by users. For pumps, valves, fittings, castings for corrosive service, etc.

DUREX (Powder metals) — Moraine Products Div., General Motors Corp., Dayton, Ohio.

Products of powder metallurgy in iron, bronze and other metals; self-lubricating bearings and various small parts for electric motors, instruments, aircraft, appliances, automotive equipment, farm equipment, washing machines, etc.

DUREZ (Thermosetting phenolic plastics)—Durez Plastics & Chemicals Inc., North Tonawanda, N. Y.

Molding powders; phenolic base, thermosetting; for molding into parts; corrosion-resistant; highly polished; low moisture absorption; heat resistance, 350-550 F; ts, 4000-7000 psi; available in colors; shock and abrasion resistant. Used for housings, handles, bases, knobs, electrical parts, small gears, frames, hoods, etc.

Liquid resin (No. 7421A); cast at room temperatures; compressive str, 15,000-20,000 psi; impact str, .11-.15 ft lb (Izod); flexural str, 7000-9000 psi; thermosetting; can be set by baking at temperatures above 100 F.

DURICHLOR (Alloy cast steel)—Duriron Co., Inc., Dayton, O.

Si 14.5, Mo 3, C 0.90, Mn 1, traces of P and S, balance Fe. For pumps, valves, pipe, castings for corrosive service, especially for hydrochloric acid and chloride solutions.

DURIMET 20 (Alloy cast steels)—Duriron Co., Inc., Dayton, O.

20; Ni 29, Cr 19, Si 1, Cu 3, Mo 2, C 0.07 max, balance Fe. For pumps, valves and castings for corrosive service, especially hot, weak sulphuric acid. Available in wrought forms from Carpenter Steel Co. as Carpenter Stainless 20. Also licensed to other foundries, known as Misco 20, Utiloy 20, etc.

DURIRON (Alloy cast steel)—Duriron Co., Inc., Dayton, O., and licensees.

Si 14.50, C 0.8, Mn 0.6, S and P traces, balance Fe. For pumps, valves, exhaust fans, mixing nozzles and castings for handling acids and other corrosive liquids and gases.

DURITE (Cast steel)—Hanford Foundry Co., San Bernardino, Calif.

High carbon, nickel, chrome, molybdenum alloy steel, furnished as sand castings. In heat-treated state: Ts, 180,000 psi; ys, 160,000 psi; elong in 2 in., 5%; Bhn, 400-425; abrasion resistance, high; wear resistance, excellent. For ball and rod mill liners, cement mixers, etc.

DURITE (Thermosetting plastics)—The Borden Co., Chemical Division, Philadelphia 24, Pa.

Phenol formaldehyde and phenol furfural thermosetting plastics in powder form for compression and transfer molding. Abrasion resistance, medium; offers good resistance to weak alkalies and acids; max cont serv temp, 250-450 F; flexural str (ASTM) D 48-43T, 8-11,000 psi; dielectric str (volts per mil, inst.) 175-460; ts 5000-7500 psi; comp str, 15-35,000 psi; produced in black and brown; moisture absorption, low; sp gr, 1.32-1.95; opaque; machinability, fair; for ignition parts, automotive parts, housings, fuse blocks, handwheels, pulleys, handles, etc.

DURODI (Alloy steel)—A. Finkl & Sons Co., Chicago 14, Ill.

A 0.50 carbon, Cr-Ni-Mo alloy steel furnished in inserts, bars and shaped pieces; heat-treated to various tempers, all commercially machinable; also annealed for hardening in oil or in air blast. For forging machine dies, inserts and mandrels and forging dies.

DURONZE ALLOYS (High-copper silicon bronzes)—Bridgeport Brass Co., Bridgeport, Conn.

High Cu-Si bronzes alloyed with elements such as Sn, Al, etc. Possess high strength combined with corrosion resistance.

Duronze I; silicon bronze; Cu 97.6, Sn 1.4, Si .1. Possesses excellent cold working properties; for making cold-headed bolts and screws, average ts, 100,000 psi in rod, wire and sheet form.

Duronze II; silicon bronze; Cu 97, Si 3. Hot-rolled sheet for making range boilers, automatic heaters, and storage tanks by either electric-arc or oxyacetylene welding methods; cold-rolled strip used as a substitute for phosphor bronze spring metal; rod and wire used for making hot-headed bolts and screw products; supplied in sheet, rod, wire and tube forms.

Duronze III; silicon aluminum bronze; Cu 91, Al 7, Si 2. Supplied in rod form only; ts, from 85,000 to 100,000 psi; hot forgings, 90,000 psi free-machining for making screw machine parts, also for sucker rods for corrosive oil wells; 10% lighter than brass; excellent corrosion resistance. In ingot form may be used for making sand castings with ts about 70,000 psi. Used for compression fittings for oil and gas lines in airplane construction, small gears, screws, pinions, oil burner nozzles, nuts, valves and valve stems, and bonnets, etc.

Duronze IV; Cu 95, Al 5, plus Arsenic. Made into condenser tubes for resisting corrosion from aerated sea water mixed with fresh water and acid wastes, sewage, etc., often found in harbors. Also for hot brine solutions in salt refining.

Duronze V; silicon bronze; Cu 98, Si 2. Wire for making difficult cold-headed parts, screws, bolts, rod, sheet. Malleable; good corrosion resistance; ts, about 100,000 psi. Recommended for cold-headed bolts and outdoor use. Also tubing for hydraulic lines on aircraft.

DUTCH BOY (Babbitt metal) — National Lead Co., New York 6.

Analysis of material varies according to the bearing application.

DYNALLOY (Alloy steel)—Alan Wood Steel Co., Conshohocken, Pa.

Alloy steel furnished in sheets, strips, and plates, for stamping, welding, cold and hot forming, etc.; abrasion resistance, medium; ts, 65-80,000 psi; ductility, high; weldability, good; fatigue and impact values, high. For structures requiring high strength.

E

E-1 to E-15 (Powder metal)—Powdered Metal Products Corp. of America, Franklin Park, Ill.

Pressed and sintered parts of powder metal having high iron content. Material has high Q and permeability values and is suitable for high and low frequency coils, permeability tuning, transformers, etc.

E-70 (Powder metal)—Powdered Metal Products Corp. of America, Franklin Park, Ill.

Pressed and sintered parts of 99% pure iron metal powder. Ts, 30,000 psi; machinability, good. Has high electrical properties; used for electrical pole pieces and armatures.

EASY-FLO (Welding rods)—Handy & Harman, New York 7.

Brazing alloy; flows at 1175 F; Ag 50, Cu 15.5, Zn 16.5, Cd 18. Resists corrosion due to silver content; sp gr, 9.49. For brazing ferrous and nonferrous metals, particularly dissimilar metals and Monel metal, stainless steel and other copper-nickel and chrome-nickel alloys. Has many electrical uses.

No. 3; for fabrication of large copper piping, etc.

No. 35; Ag 35, Cu 26, Zn 21, Cd 18. Furnished in coiled strip, wire and sheet. Sp gr, 9.06, nonmagnetic. For ferrous, nonferrous and dissimilar metal which can be heated to the flowing temperature of 1295 F. Starts to melt at 1125 F.

No. 45; Ag 45, Cu 15, Zn 16, Cd 24. Furnished in coiled strip, wire and sheet for brazing. In cold-worked state: Sp gr, 9.34; nonmagnetic. Used to join metals that can be heated to 1145 F. Joins ferrous, nonferrous and dissimilar metals. Flows fast and spreads rapidly.

EBROK (Bituminous plastics)—The Richardson Co., Melrose Park, Ill.

Acid-resisting bituminous plastics for specific requirements including such parts as battery containers.

ECLIPSE (Seamless flexible metal hose)—Metal Hose Dept., Bendix Aviation Corp., Teterboro, N. J.

Bronze 85/15, or 3% silicon steel, 3% silicon bronze, 1010 steel, Monel, stainless steel and various other alloys. Tubing resists corrosion caused by salt water, ammonia, steam, gases, etc. Has high ductility.

ECONOMO 17 (Carbon steel)—Wheelock, Lovejoy & Co. Inc., Cambridge 39, Mass.

Carbon steel conforming to AISI C-1117; special bar quality furnished in rough bars or billets and finished rods or bars. Machinability, good; weldability, good. For shafts, spindles, gears, etc.

ECONOMY HARDFACE (Welding rod)—American Manganese Steel Div., American Brake Shoe Co., Chicago Heights, Ill.

C-Cr-Mo: For hard facing only; bhn, 450-500; martensitic steel deposits, nonmagnetic. Self-hardening; high abrasion and severe impact resistance; responds to heat treatment; can be forged. For hard facing quarrying, excavating, mining, construction, and steel mill wearing parts.

EEL-SLIP (Composite material)—Johns-Manville, New York 16.

Asbestos fiber, graphite and rubber compound; heat-resistant; high tensile strength; noninflammable. Used for bearings, suction box covers, etc.

EIS 45 (Chrome steel)—Heppenstall Co., Pittsburgh.

Chrome steel; C 0.85, Cr 12. Furnished for hot forging into parts. Used for shear blades for shearing medium heavy material.

EIS 57 (Nickel-chrome-molybdenum steel)—Heppenstall Co., Pittsburgh.

C 0.6. For insert and hot die steel service.

ELASTI-GLASS (Thermoplastic plastics) — S. Buchsbaum & Co., Chicago 16.

Vinylidene chloride copolymers and vinyl chloride acetate copolymers, thermoplastic; furnished in sheets and rolls or film, and in extruded rods or shapes; also for compression molding and extruding into parts. Chemically resistant to almost all solvents. Has high dielectric str; available in all colors; moisture absorption, low. For diaphragms, valve seats or protective covers.

ELASTO-RIB (Vibration dampening material)—The Korfund Co. Inc., Long Island City 1, N. Y.

Vibration controlling material generally placed under machine footings. Consists of a layer of cork between two layers of deep-grooved, high-grade rubber. Is 1-in. thick and available in pads of any area required. Recommended loading range is between a minimum of 1000 and a maximum of 2500 pounds per square foot.

ELASTRON (Flexible plastics)—Industrial Synthetics Corp., Garwood, N. J.

Polyvinyl family; furnished glossy to smooth dull finishes for stamping, embossing and printing; available in variety of colors, transparent, translucent or opaque; exceptionally tough; flexible; light in weight; noninflammable; inert to alcohol or oil splashes, salt water proof. For bumpers, for household appliances, and other industrial applications.

ELASTUF (Alloy steels)—Horace T. Potts Co., Philadelphia 34.

Type A-2; heat-treated and stress relieved special chrome-vanadium with small controlled amounts of nickel and molybdenum; hot rolled. Further heat treating after machining not recommended. Ts (up to 2 in.), 125-145,000 psi; ys, 115-135,000 psi; elong in 2 in., 10-17%; reduction of area, 38-50%. Heat-treated alloy steel with high physical properties in machinable conditions; uniform hardness and strength throughout cross-sec-

tions of all sizes; good heat and wear resistance.

Type "44"; heat-treated and stress relieved. Special analysis including chrome, nickel and molybdenum; hot rolled. Ts (up to 2 in.), 190-220,000 psi; ys, 175-200,000 psi; elong in 2 in., 10-17%; reduction of area, 38-50%. Machinable at 42-26 Rockwell C. Has high tensile properties in machinable condition.

Type JJ Soft Steel; hot-rolled; C 0.18-0.23 (an improved analysis soft steel); furnished in bars. Carburize 1650-1700 F, cool in box, reheat to 1400-1450 F, quench in water, draw to 250-500 F. In untreated state: Ts, (up to 2 in.), 60-70,000 psi; ys, 35-45,000 psi; elong in 2 in., 25-35%; reduction of area, 50-60%; weldability, good. Recommended for all soft steel uses; excellent for forging, welding, bending.

Chro-moly (heat treated); heat-treated alloy steel of good tensile properties, high impact strength and shock resistance, excellent creep characteristics. Ts (up to 2 in.), 130-150, 000 psi; ys, 110-125,000 psi; elong in 2 in., 18-22%; reduction of area, 50-60%. For use as axles, heavy-duty, high-temperature and high-pressure bolts, etc.

Media: Precision Finish; analysis same as AISI C-1040 and SAE 1040; furnished in finished bars (turned, ground and polished). Normalize at 1650-1700 F, cool in air, heat to 1500-1550 F, quench in water, draw to desired hardness. Ts (up to 2 in.). 90-105,-000 psi; ys, 75-90,000 psi; elong in 2 in., 10-20%; reduction of area 35-50%; good weldability and machinability. For use where accuracy to size and straightness is needed.

Hot-Rolled; analysis same as AISI C 1045 and SAE 1045; furnished in hot-rolled bars. Normalize at 1650-1700 F, cool in air, heat to 1500-1550 F, quench in water, draw to desired hardness. Ts (up to 2 in.), 80-95,000 psi; ys, 45-60,000 psi; elong in 2 in., 15-25%; reduction of area, 30-45%; good weldability and machinability, and high tensile strength.

Penn; hot-rolled; approx 0.45 carbon, special analysis. Normalize at 1650-1700 F, cool in air, heat to 1525-1550 F, quench in water, draw to desired hardness. Ts (up to 2 in.), 100-125,000 psi; ys, 60-75,000 psi; elong in 2 in., 15-25%; reduction of area, 30-45%; weldability, good; machining qualities, good.

Cold-Finished Penn; approx 0.45 carbon, special analysis. Normalize at 1650-1700 F, cool in air, heat to 1525-1550 F, quench in water, draw to desired hardness. Ts (up to 2 in.), 110-135,000 psi; ys, 100-115,000 psi; elong in 2 in., 12-22%; reduction of area, 35-50%; weldability, good; same quality as Hot-Rolled with better machinability and higher tensile properties in cold-drawn sizes (up to 3 in. dia.).

Strainfree Penn Cold-Finished; approx 0.45 carbon, special analysis. Furnished in finished bars. Normalize at 1650-1700 F, cool in air, heat to 1525-1550 F, quench in water, draw to desired hardness. Ts (up to 1 in.), 125-145,000 psi; ys, 110-120,000 psi; elong in 2 in., 10-20%; reduction of area, 30-45%; weldability, good; specially processed to give tensile properties equal to many heat-treated alloy steels. Free from warping in machining. For lead and feed screws and miscellaneous machine parts.

ELECTRAPANE (Glass with electrical conducting film)—Libbey-Owens-Ford Glass Co., Toledo, O.

Furnished in sheet and plate. Abrasion resistance, medium chemical resistance, same as regular glass; noninflammable; medium flexibility; is not shatterproof but stronger than untempered glass; transparent. Used for electrostatic dissipation, de-icing, and other uses subject to investigation.

ELECTROMET (Alloying elements) — Electro Metallurgical Sales Corp., New York 17, N. Y.

A complete line of ferro-alloys and alloying elements of various analyses.

ELECTRUNITE (Electric welded steel tubing)—Steel & Tube Div., Republic Steel Corp., Cleveland 8.

In stainless, carbon and various alloy steels. Square, rectangular, oval, or other shapes, in any size or gage where the periphery of the shape is not less than 2-1/32 in. or more than 16 in. Furnished in following analyses: SAE 1010-1035, NE-8630, X-4130 and in stainless steels types 302, 302-B, 304, 309, 316, 317, 321, 347 and 446. Used for general mechanical, structural, aircraft, conduit, boiler, condenser, heat exchanger and other pressure applications. For data on properties, characteristics and applications for stainless steels see "Stainless Steels" listing at end of this section.

ELEMITE (Ceramics)—The Louthan Mfg. Co., East Liverpool, O.

Five types of Cordierite refractory, two types of vitrified porcelain, three types of steatite and five types of porous refractories. Furnished in rods or tubes and special shapes. Refractories offer low thermal expansion, high resistance to heat shock, have excellent electrical properties. Steatite offers low loss, high mechanical strength, close tolerances. Porcelains offer high dielectric strength.

ELEPHANT BRAND (Phosphor bronze)—The Phosphor Bronze Corp., Philadelphia.

Strip and sheet in coils or lengths, various tempers, plain or tinned, 40 B&S (0.0031-in.) to bridge plates.

Wire: Spring or other tempers, 40 B&S (0.0031-in.) to ¾-in. diam; furnished in coils or straightened lengths. Also special-purpose wire, such as tinned binding wire for armatures, etc.

Rods: Complete range of sizes and alloys. 0.010-in. to 4¾-in. diam.; hex., ⅛ to 2 5/16-in.; squares, ⅛ to 2¼-in. Also in many rectangular and special shapes.

Rope: Wire, 7-wire strand; 6 x 7; 6 x 19; and 6 x 42 construction; 1/32 to ¾-in. diam.

Castings: Special alloys for bearings, gears, special applications. Stock patterns available ½ to 10 in. OD. Standard cores, ½ to 7¾-in. ID.

ELKALOY (Welding electrode)—P. R. Mallory & Co., Inc., Indianapolis.

A work-hardened alloy of copper, not heat-treatable, for spot and seam welding aluminum and its alloys, unpickled hot-rolled steel, terne plate, galvanized iron and other materials. A direct substitute for copper, it handles the same but is harder and lasts longer.

ELKONITE (Electrical contact materials)—P. R. Mallory & Co., Inc., Indianapolis.

Three definite classes of materials. One group based on copper and such refractory metals as tungsten, molybdenum and their carbides—combinations which produce material with good electrical conductivity and great wear-resistant qualities, for use as welding electrodes and contactors in oil immersed circuit breakers. Certain of these grades are heat treatable. The heat treatment improves electrical and physical properties.

Second group based on silver and refractory material such as tungsten, molybdenum, and their carbides, and has been developed primarily as a facing material for heavy-duty electrical contacts and contactors for air breakers.

Third group comprises basically silver in which is incorporated refractory material such as cadmium oxide or nickel. These materials are used as heavy contacts, particularly for aircraft, relays, and contact facings and main contacts on heavy-duty breakers.

All three groups can be used in the form of thin facings or as inserts with copper or copper alloy backing materials, having high electrical conductivity coupled with high physical properties.

ELKONIUM (Electrical contact materials)—P. R. Mallory & Co., Inc., Indianapolis.

A series of electrical contact materials divided into the following groups: Silver, platinum, palladium and gold-base alloys. These groups are designed to cover a wide range of applications and can be supplied in a wide variety of forms.

ELVACET (Polyvinyl acetate plastic)—E. I. du Pont de Nemours & Co., Inc., Arlington, N. J.

Thermoplastic; supplied in solid beads of low, medium and high viscosity for molding or casting, in solution (50% in methanol), and as water emulsion. Soluble in common organic solvents for use as adhesive, compatible with resins, cellulose derivatives and chlorinated rubber. Used as adhesive, binding agent, also as protective coating on machine parts.

ELVANOL (Polyvinyl alcohol plastic)—E. I. du Pont de Nemours & Co., Inc., Arlington, N. J.

Polyvinyl alcohol, thermoplastic; in powder form for molding and solvent-resistant rubber substitutes, textile sizings, paper coatings, and adhesives. Highly flexible; dielectric str, low; heat-resistant to 200 F; takes color; shatterproof; sp gr, 1.21-1.31 (powder); translucent; resistant to organic solvents. Used for oil-resistant gaskets, tubes, rollers, etc., as well as protective coatings on metal parts.

ELVERITE (Special cast iron)—The Babcock & Wilcox Co., New York 6, N. Y.

Sand cast and chill cast plain and alloyed wear iron. For tube mill liners, roll heads, jaw crushers and special applications.

EMPIRE (Sheet insulation)—Mica Insulator Co., Schenectady, N. Y.

Varnished paper, Fiberglas and fabric, furnished in sheet form. Used for electrical insulation in armature, stator, field, transformer and regulator coils, for coil wrapping, high tension cable splices, slot cells, phase insulation, etc.

ENDURO (Stainless steels)—Alloy Steel Div., Republic Steel Corp., Massillon, O.

Standard stainless steels of AISI type. For data on types, properties, characteristics and applications see "Stainless Steels" listing at end of this section.

ERAYDO Alloy (Strip and sheet zinc)—Illinois Zinc Co., Chicago 32.

99% zinc, ½ to 1% copper, plus other minor elements. Furnished in straight and coiled strip, sheet and plate. In cold-worked state: Ts, 28-54,000 psi; machinability, good; weldability, poor; max cont serv temp, 200 F; sp gr, 7.14. Used for nameplates, guards, housings and cases.

ERMALITE (Alloy iron)—Erie Maleable Iron Co., Erie, Pa.

Wear-resisting alloy iron; for wearing plates, friction drums and other parts subject to high stresses or wear.

ERMAL Z-Metal (Pearlitic-malleable iron)—Erie Malleable Iron Co., Erie, Pa.

A spheroidized pearlitic-malleable iron; for castings requiring rigidity, high-tensile strength, and abrasion resistance. Suitable for heat treatment.

ES (Stainless steel sheets)—Eastern Stainless Steel Corp., Baltimore 3, Md.

For type, property and application data, see "Stainless Steels" listing at end of this section.

ESCO (Cast Steels)—Electric Steel Foundry Co., Portland 10, Oreg.

Stainless, manganese, carbon and low alloy steel castings to all commercial analyses.

ETHOCEL (Dow ethylcellulose plastics) — The Dow Chemical Co., Midland, Mich.

Plastic granules, thermoplastic; furnished in granular form for injection and extrusion molding; dielectric str, 1500 volts per mil on 0.01-in. thickness; ts, 7000-8500 psi; comp str, 10-12,000 psi; heat resistance, 130-150 F; high impact strength at low temperature; low moisture absorption; good dimensional stability; available in color; sp gr, 1.08-1.16; translucent, opaque. Used where dimensional stability and toughness are required. Also furnished in sheeting.

EUREKA (Welding electrodes)—Welding Equipment & Supply Co., Detroit 7.

Tool and die welding electrodes. Also alloy welding electrodes for welding cast iron and bronze castings.

EUTECROD (Welding rod)—Eutectic Welding Alloys Corp., New York 13.

Scientifically developed welding rods which are used with special fluxes and utilize the principle of surface alloying at low heats. These welding rods can be applied with the oxyacetylene torch, oxyhydrogen torch, and induction and furnace heating.

EUTECHROM (Welding rod)—Eutectic Welding Alloys Corp., New York 13.

Also fluxes for building up new or worn surfaces subject to abrasive wear, and/or to maintain hard and sharp cutting edges. The rods are available either bare or flux-coated for use with the oxyacetylene torch and metallic and carbon arc.

EUTECTIC (Welding alloys)—Eutectic Welding Alloys Corp., New York 13.

Welding alloys and special fluxes of a new type that bond to the parent metal below the melting point of the latter, forming exceedingly strong bonds through surface alloying at low heats.

Scientifically developed welding rods which are used with special fluxes and utilize the principle of surface alloying at low heat. These welding rods can be applied with the oxyacetylene torch, metallic and carbon arc, and induction and furnace heating.

EUTECTOFILM (Welding rod coating)—Eutectic Welding Alloys Corp., New York 13.

A scientifically developed coating which is used on Eutectic low-temperature welding rods to enhance their welding properties and to assist in surface alloying at low heat.

EUTECTRODE (Welding electrode) — Eutectic Welding Alloys Corp., New York 13.

Scientifically developed electrodes which utilize the principle of surface alloying. These special flux-coated electrodes are for use with the metallic arc process.

EVANSTEEL (Alloy steel casting) — Chicago Steel Foundry Co., Chicago 32.

Ni 1-1.5, Cr 0.65-1, C varies from 0.3-0.5, sometimes carries additions of V or Mo. For castings such as passenger car knuckles, tooth bases, sprockets, gears, high pressure valves, etc. In general, for parts requiring high tensile strength plus good shock and abrasion resistance.

EVERDUR (High copper alloys) — American Brass Co., Waterbury, Conn.

Alloy No. 1010; Cu 95.8, Si 3.1, Mn 1.1. Uses include welded tanks and sewage disposal apparatus.

Alloy No. 1012; Cu 95.6, Si 3.0, Mn 1.0, Pb 0.40; made in rod only for automatic screw machine production.

Alloy No. 1000; Cu 94.9, Si 4.0, Mn 1.1; made in notched ingots for remelting.

Alloy No. 1014; Cu 91.0, Si 2.0, Al 7.0; made in rods only for automatic screw machine production and hot forging.

Alloy No. 1015; Cu 98.25, Si 1.5, Mn 0.25; easily fabricated by all methods including welding. Used for tubes, bolts and screws.

EXCELSIOR (Electrical resistance alloy)—Alloy Metal Wire Co., Inc., Prospect Park, Pa.

Furnished in round and flat wire and rod. Ni 45, Cu 55. Used for wire wound resistors, controllers, instruments and other equipment where exacting electrical resistance, good resistance to oxidation and ease of soldering are required.

This company also handles nickel, Grades A, D and E Monel, "R" Monel, "K" Monel, "KR" Monel, "Z" Nickel and Inconel. For property and application data on these, see listings under material name.

EXPANDED METAL—Penn Metal Co. Inc., Boston 9.

Expanded sheets of carbon steel, stainless steel, aluminum, copper Monel metal, etc., combining maximum strength with lightness. For machine guards, ventilation around motors, shelving, racks, drying trays, grating, filters, etc.

F

F-10 to F-80 (Powder metal)—Powdered Metal Products Corp. of America, Franklin Park, Ill.

Pressed and sintered parts of bronze, nickel and stainless steel powder metals. Used for filtering oil and water, mixing of gases, controlling flow, etc. In air conditioning units, refrigerating units, gas burners, etc.

FABROIL (Fiber material) — General Electric Co., Chemical Dept., Pittsfield, Mass.

Oil treated, furnished in gear blanks for machining. Has high impact resistance. Used for gears.

FAHRALLOY (High alloy steel)—The Fahralloy Co., Harvey, Ill.

Various grades. Ni 65, Cr 5-30, Mo 0-3, C 0.07-1.00, balance Fe. Furnished as sand castings, no heat treatment required. Ts, 80,000 psi; ys, 40,000 psi; elong in 2 in., 30%; Bhn, 160-400; sp gr, approx 7.00; weldability, good; max cont serv temp, 2000 F. Used for heat treating furnaces, food machinery, ore roasters, etc.

Ni 65; Cr 14-30, C .07-2. Furnished as sand castings to specification. In unheat-treated state, ts, 75,000 psi; ys, 40,000 psi; elong in 2 in., 1-40%; bhn, 200-400; sp gr 7.9. Machinability, fair; weldability, good. Resists corrosion caused by most acids, gases and high temperature; max cont serv temp, 2000 F.

FAHRITE (Alloy steel castings)—The Ohio Steel Foundry Co., Springfield, Ohio.

Group of heat resistant alloy steels and group of corrosion resistant alloy steels primarily of the chromium-molybdenum type. Castings produced to specification.

FAIRPRENE (Synthetic rubber-coated fabrics)—E. I. du Pont de Nemours & Co. Inc., Fabrics Div., Fairfield, Conn.

Woven fabrics of cotton, nylon, rayon, glass, asbestos or felt, fibers, etc., coated with oil-resistant synthetic rubber. Used for parts such as diaphragms, gaskets, washers, packings, shock and insulating pads, seam sealing, and similar applications in the chemical, oil and other industries.

FALLS (Wrought iron)—Falls Hollow Staybolt Co., Cuyahoga Falls, O.

C 0.016, P 0.099, Si 0.114, Mn 0.33, S 0.018; furnished in rough bars or billets for machining. In untreated state: Ts, 48-52,000 psi; elong in 8 in., 30%; weldability, very good; machinability, good. For staybolts in locomotive type boilers.

FANSTEEL (Corrosion-resistant, high-strength metals)—Fansteel Metallurgical Corp., North Chicago, Ill.

Molybdenum; Mo 99.9+; in finished rods or bars, wire, sheets, strips and powder metal; for stamping, turning, boring, welding into parts. Ts, 260,000 psi; impact resistance, high; Bhn, 147; sp gr, 10.2; nonmagnetic; resists corrosion caused by most acids; heat-resistant to 3000 F in protective atmosphere; abrasion resistance, medium. Used for critical electrical parts.

Tantalum; Ta 99.9+; finished rods or bars, tubing, wire, sheets and strips; for stamping, turning, boring, welding, etc. Ts, 42-178,000 psi; impact resistance, medium; Bhn, 75-125; sp gr, 16.6; nonmagnetic; weldability, good. For corrosion-resisting parts.

Tungsten; W 99.95; furnished in rough bars or billets, finished rods or bars, wire, sheets, shapes, powder metal and ribbon; for forming, fabricating and powder metallurgy. Mechanical properties in untreated state; ts, 490,000 psi; impact resistance, high; Bhn, 290; sp gr, 19.3; magnetic; resists corrosion caused by most acids; abrasion resistance, high.

FARLITE (Thermosetting plastics sheets)—Farley & Loetscher Mfg. Co., Dubuque, Iowa.

Phenolic and melamine base, thermosetting materials; for machining and stamping into parts; corrosion-resistant; highly polished; low moisture absorption; impact-resistant; available in colors; ts, 10-12,000 psi; dielectric str, to 700 volts per mil. Used for circuit barriers, panel boards, washers, terminal strips, and for parts requiring moderate chemical resistance.

Gear stock; fabric base. Furnished in blanks of desired thickness; high moisture resistance; ts, to 11,000 psi; comp str, 39,500 psi; flex str, to 20,000 psi; and dielectric str, to 700 volts per mil.

Grade FCM-81-H, melamine glass laminate; thermosetting; furnished in laminated sheet form. Abrasion resistance, high; resists weak acids, moderate caustic, all solvents; max cont serv temp, 300 F; flexural strength (ASTM D 650-42T), 32,000 psi; dielectric strength (volts per mil. inst.), 300; ts, 38,000 psi; available in the color brown; moisture absorption, 1% in 24 hr of water; sp gr, 1.96; is opaque; machinability, poor; Bhn, 50; coefficient of thermal expansion; 3 x 10^{-5} inch/inch/degree C.

FARLITE COMPREG (Plastic-impregnated wood veneer)—Farley & Loetscher Mfg. Co., Dubuque, Iowa.

Wood veneer impregnated with thermosetting synthetic resins before compressing; available in several grades. Thicknesses to 2 in.; for machining with same tools as for cast iron. Material has good impact and corrosion-resistance; has low moisture absorption; ts, 30,000 psi; comp str, 23,000 psi; good dimensional stability; modulus of rupture in bending, 35,000 psi. Used for bearing plates, bolts, studs, propeller blades, instrument panels, mechanical spacers, etc.

FARMFACE (Welding rod)—American Manganese Steel Div., American Brake Shoe Co., Chicago Heights, Ill.

Cr-Mo-Ni-C-Si: For hard facing only; bhn, 500-600; martensitic iron deposits, slightly magnetic; high abrasion resistance; no heat treatment required; scours easily; high fluidity; easy flowing. For hard facing agricultural parts, such as plow shares, cultivators, shoes, corn planter runners, lister shares, plow disks, cylinder teeth, etc.

FARRELL (Abrasion-resisting cast steels)—Farrell-Cheek Steel Co., Sandusky, O.

Hard Edge; alloy steel, carbon penetrated, furnished as sand castings; high abrasion resistance; high tensile strength and ductility; Bhn, heat-treated, 650-700 and higher. For crane wheels, conveyor and elevator chains, sprockets, elevator buckets, etc.

Regular Carbon; C 0.20-0.30, Si 0.30-0.45, and Mn 0.60-0.75; furnished as sand castings. In heat-treated annealed state; ts, 111,500 psi; ys, 93,000 psi; elong in 2 in., 28%; Bhn, 140; magnetic; machinability, good. For parts requiring high ductility, medium strength and good machinability.

No. 0.25 carbon steel; furnished as centrifugal castings in annealed state.

No. 0.40 carbon steel; C 0.35-0.45, Si 0.30-0.45, Mn 0.70-0.80; furnished as sand castings. In heat-treated state; ts, 115,000 psi; ys, 84,000 psi; elong in 2 in., 18%; magnetic; weldability, good; abrasion resistance, medium. For parts requiring medium-high tensile strength and good abrasion resistance.

No. 85; specially processed steel castings for resisting abrasion. In heat-treated state; ts, 111,500 psi; ys, 93,000 psi; elong in 2 in., 20%; Bhn, 235; magnetic; weldability, good; abrasion resistance, high. For parts requiring high tensile strength and ductility.

FEATHERWEIGHT (Magnesia composition) — Keasbey & Mattison Co., Ambler, Pa.

Magnesia blocks, pipe covering and cement. Combination of magnesia and asbestos fiber with exceptionally low thermal conductivity and light density. Used as a thermal insulating material where temperature does not exceed 600 F.

FEDERAL (Bronzes)—Federal Mogul Corp., Detroit.

F1; a gear bronze suitable for heavily loaded piston pin bushings, etc.

F2; lead bronze for average bushings application.

F3; used largely as backs for babbitt-lined bearings.

F5; widely used for babbitt-lined bearing backs and for bushings where service is not severe.

F6; Can be used for average bushing applications, but requires good lubrication.

F8; good casting and machining qualities.

F11; for piston pin bushings and other low speed, heavily loaded applications.

F15; has 20 per cent lead and may be used safely under adverse lubrication conditions.

F16; because of high lead content may be used where only occasional lubrication is possible.

F18; high lead alloy of good casting characteristics.

F20; a hard bronze used for gears and worm wheels where requirements are severe; also aluminum-bronze and special analysis bronzes.

F-28; for use as compressor seals in refrigerators, ventilating equipment and similar applications.

FELPRO (Fiber-rubber-cork-felt material)—Felt Products Mfg. Co., Chicago 7.

Furnished in sheets and strips and in fabricated parts. Can be stamped or extruded into parts. Used for gaskets, metallic, semi-metallic, and fibrous valve and pump packings for all applications.

FELTAN (Rubberized felt)—American Felt Co., Glenville, Conn.

Microporous sheet material, also available in strip or cut parts; for stamping. Abrasion resistance, medium; chemical resistance, as required; max cont. serv. temp, 300 F; nonflammable; flexibility, high; ts, 100 psi; transverse str, 10 psi; flexural str, high; elongation, 1500 per cent; moisture absorption, high; available in red, brown, black, grey, tan and white; opaque; shatterproof; sp gr, 1.2. Nonskid surfacing material for instruments, machines and vibration mountings, filters, etc.

FELTERS (Felts)—The Felters Co., Boston.

Nonwoven felts manufactured to highest standards and in accord with SAE and other specifications. Available in piece, roll, strip, or in parts precision-cut to specific requirements. Uses include pads, bumpers, anti-squeak and anti-rattle parts, filters, polishing roll covering, shaft and bearing seals and other applications. Petroleum-resistant.

FERROWELD (Welding electrode) — Lincoln Electric Co., Cleveland.

For arc-welding cast iron. Has steel base to give solid weld on cast iron of greater tensile strength than the cast iron itself. Due to low current which can be used, hardening effect usually present along the line of fusion is materially reduced.

FIBERGLAS (Glass fiber materials) — Owens-Corning Fiberglas Corp., Toledo, O.

Wool and textile; Three kinds of wool-type fibers: (1) for thermal and acoustical insulation, compressed to various densities, in form of batts, blankets, blocks, etc.; (2) for thin porous bonded mats; (3) for filter or aeration packs (coarse fibers). Two types of textile fibers—continuous filament and staple fiber—for service fabrics, chemical filtration, electrical insulation, reinforcement in laminates, plastics, etc. Basic properties; light weight, low thermal conductivity. Wool products have good sound absorption, are resistant to moisture, individual fibers are incombustible, durable, sanitary, wide temperature range (from subzero to 1000 F).

Thermal insulations include medium and high-temperature blocks, low-temperature (asphalt-enclosed) blocks, pipe insulations, metal mesh blankets, etc., for all industrial equipment applications.

Electrical insulations for magnet wire, motors, generators, transformers — varnished cloths used for high temperature cambric applications; inorganic backing and reinforcement in mica combinations; for producing electrical laminates; for high temperature electrical adhesive tape. Tapes used for binding coils and other parts to be impregnated after wrapping; various electrical applications. Electrical tying cord for binding coils in generators and armatures, in transformers and similar static applications. Braided sleevings are used for lead wires in motors and transformers and similar applications.

Industrial textiles for high temperature pipe lagging, welding curtains.

Dust-Stop air-filters; used wherever air is moved mechanically in ventilating, heating and air-conditioning systems and in forced warm air furnaces and packaged air-conditioners.

FIBESTOS (Cellulose acetate plastics)—Monsanto Chemical Co., Plastics Div., Springfield 2, Mass.

Thermoplastic; furnished in sheet, laminated and powder forms, for molding, machining, stamping or swaging into parts; resistant to corrosion; transparent; available in colors; flexible; tough; high polish; dielectric str, 290-600 volts per mil; ts, 5500-10,000 psi. Used for safety glass, and compressible shims, couplings, gaskets, electrically insulated knobs and handles, light diffusing panels, and molded shapes of all types.

FIBRON (Plastic tape and tubing)—Irvington Varnish & Insulator Co., Irvington, N. J.

Plastic tape; polyvinyl chloride, thermoplastic; heat-sealing, flame-resistant tape for insulating and protecting against abuse and corrosion of wires, cables and electrical equipment; suitable also for splicing electrical cables and for covering piping and equipment exposed to acids, alkalies, moisture, oil and grease. Dielectric str, 1000 volts per mil for tape of 0.012-in. thickness; ts, 1600 psi.

Plastic tubing, No. 5373; polyvinyl chloride, thermoplastic; furnished in rods and tubes for extruding. Abrasion resistance, high; chemical resistance, good; max cont serv temp, 180 F; dielectric str, 1000 volts per mil; ts, 3000 psi; available in black, green, red, white, yellow and blue; moisture absorption, low; machinability, good. For wire insulation, conduit, lug insulation, etc.

FINKL (Alloy steel)—A. Finkl & Sons Co., Chicago.

CNM; Cr-Ni-Mo; C 0.40; furnished heat-treated to various tempers. For large-section forgings or forgings of irregular section not suitable for heat-treating by liquid quenching.

FS annealed; C 0.50, Cr, Ni and Mo; oil quench; for die blocks. Miscellaneous forgings subject to forging temperatures and/or abrasion.

FX; C 0.55, Cr, Ni, and Mo; furnished heat treated to various tempers, all commercially machinable. For use as drop hammer dies and blocks, forging machine dies, backing-up rolls and dipper teeth.

FIRECRETE (Castable refractory) — Johns-Manville, New York 16.

For furnace covers and bottoms, door linings, special shapes and many other types of monolithic refractory construction. Furnished in four grades; Standard Firecrete for temperatures up to 2400 F; High Temperature Firecrete up to 2800 F; Light Weight Firecrete up to 2400 F; and 3X Firecrete up to 3000 F.

FIRTHALOY (Tungsten-carbide)—Firth-Sterling Steel and Carbide Corp., McKeesport, Pa.

Highly developed form of sintered carbide adapted to wire drawing dies, extrusion dies and similar purposes.

FIRTHITE (Tungsten-carbide) — Firth-Sterling Steel and Carbide Corp., McKeesport, Pa.

Hard metal composition of sintered carbides furnished in a number of grades to form wearing surfaces or the edges of cutting tools.

FIVEPOINT DEEPHARD (Hardened steel) — Foote Bros. Gear & Machine Corp., Chicago.

Low-carbon steel parts, regardless of SAE or NE type, manufactured by the company and hardened by its Five Point Deephard process which can be applied also to castings, forgings, bars or plate steel, and results in superior wearing qualities. Company also has special alloy steel of a nickel-moly-chrome analysis, used especially to improve cores where it is otherwise impossible to obtain core hardness over 300 Brinell because of excessive bulk. Furnished complete only as gears, pinions, or machine parts.

FLEETWELD (Welding electrodes) — Lincoln Electric Co., Cleveland.

Shielded arc electrodes for welding mild steel:

Type 5; for flat, vertical and overhead welding. Ts, 65-75,000 psi; impact resistance, 30-70 ft-lb (Izod); AWS Class E-6010.

Type 7; for general-purpose welding and where fit-up is not of the best; low spatter and slag loss, high burn-off rate. Physical properties as welded: ts, 70-80,000 psi; yield point, 55-66,000; ductility, approximately 17 per cent elong. in 2 in.; sp gr, 7.80. AWS Class E-6012.

Type 11-HT; heavily coated electrode of shielded arc type for deep-groove welding in a flat position of high tensile steels. AWS Class E-7020.

Type 11; heavily coated electrode of shielded arc type for downhand fillet welding with "Fleet-Fillet" technique. AWS Class E-6020.

Type 35; for flat, vertical and overhead welding on both ac and dc. Physical properties similar to Type 5 electrode. AWS Class E-6011.

Type 37; for flat, vertical and overhead welding on mild steel. Especially designed for welding sheet metal. Physical properties similar to Fleetweld 7. AWS Class E-6013.

Type 47; for flat, vertical and overhead welding on mild steel where ease of operation and cleaning are essential. Properties similar to Fleetweld 7. AWS Class E-6013.

FLEXSEAL (Laminated shatterproof plate glass)—Pittsburgh Plate Glass Co., Pittsburgh 19.

Laminated plate glass with extended Vinyl plastic edge, furnished in flat and bent sheets. Corrosion and abrasion resistance, high; heat-resistant to 180 F; flexibility, medium; moisture absorption, low; shatterproof; transparent; highly polished; flexible edge simplifies installation. For windows having nonrigid frames or windows requiring an airtight edge seal.

FLYLITE (Magnesium-base alloy)—Magnesium Div., Howard Foundry Co., Chicago.

Grade No. 8; Al 5.3-6.7, Mn 0.15 min, Zn 2.5-3.5, Si 0.3 max, Cu 0.05 max, Ni 0.005, others 0.3, Mg remainder. As cast: for castings requiring moderate strength and toughness. Heat-treated; for castings requiring high strength and maximum toughness. Heat-treated and aged; for castings requiring high yield strength, hardness, moderate toughness.

Grade No. 4; Al 8.3-9.7, Mn 0.1 min, Zn 1.7-2.3, Si 0.3 max, Cu 0.05 max, Ni 0.005, others 0.3, Mg remainder. Characteristics similar to Flylite No. 8. Flylite No. 4 is preferred for maximum pressure tightness.

FOLLANSBEE (Cold rolled strip steel)—Follansbee Steel Corp., Pittsburgh 22, Pa.

Carbon steel of AISI analysis furnished in straight and coiled strip.

FORMETAL (Bushings and bearings)—National Formetal Co. Inc., Cleveland 14.

Bearings, bushings, sleeves, ferrules, tubes in short lengths of any metal or alloy, to specification.

FORMICA (Laminated thermosetting plastics)—The Formica Co., Cincinnati 32.

Resinous base, thermosetting; furnished in laminated form, for machining or stamping into parts; corrosion-resistant; tensile strength is slightly less than cast iron; high dielectric strength; absorbs no oil; changes in dimensions only slightly as the result of moisture absorption. Used for insulating washers and bushings, punched parts in switches, automotive starting systems and all types of heavy-duty gears.

Grade C: Phenolic laminated fabric; thermosetting; furnished in sheets and in rods or tubes; can be highly polished; corrosion-resistant to acids and salts, not alkalies; flexible in thin sections; dielectric str, 200 volts per mil in 1/16-in. thick, ts, 10,000 psi; heat resistant to 300 F. Used for silent gears.

Grade CNP-22: Laminated phenol-formaldehyde; furnished in sheets, rods or tubes for machining into parts. Abrasion resistance, high; resistant to all electroplating solutions except chromic acid; max cont serv temp, 275 F; flexibility, low; dielectric str, 200 volts per mil; ts, 7500 psi; flex str, 12,500 psi; moisture absorption, low; shatterproof; sp gr, 1.36; opaque; available in natural (tan); machinability, fair. For chemical resistant parts such as gears and panels for electroplating equipment.

Grades CJP-11 and CBP-11: Laminated phenol-formaldehyde, thermosetting materials; furnished in sheets up to 36 x 96 in.; Abrasion resistance, medium; max cont serv temp, 275 F; flex str, 17,000 psi (ASTM D 650-42T); ts, 9000 psi; comp str, 36,000 psi (flat); available in olive green (CIP-11), and black (CBP-11); moisture absorption, medium; sp gr 1.36; opaque; machinability, good. A post-forming grade for bending or

drawing into various shapes after pressing. Formed shapes have good rigidity and dimensional stability.

Grade FF-55: Melamine formaldehyde, thermosetting; furnished in laminated sheets up to 36 x 96 in., and in rods and tubes. Abrasion resistance, medium; chemical resistance, not recommended except for use with water or very mild alkali solutions; max cont serv temp, 390 F; flex str, 35,000 psi (facewise) and 40,000 psi (edgewise) (ASTM D 650-42T); dielectric str, 500 volts per mil; ts, 25,000 psi; comp str, 55,000 psi (flat); impact str, 12 ft lb/in. notch (Izod); available in light brown, opaque; moisture absorption, medium. For parts requiring good arc and fire resistance together with good mechanical strength, such as electrical instrument panel boards.

Grade LN-41: Laminated melamine formaldehyde, thermosetting; furnished in sheets, rods or tubes for machining. Abrasion resistance, medium; very resistant to alkaline solutions but poor resistance to acids; max cont serv temp, 280 F; flexibility, low; ts, 20,000 psi; dielectric str, 370 volts per mil; comp str, 44,000 psi; flex str, 26,000 psi; moisture absorption, low; produced in ivory, opaque; sp gr. 1.5; shatterproof. For electroplating barrel parts for alkaline solutions and other electrical fabricated parts requiring electrical arc resistance.

Grade RN-30: Random cotton-phenolic laminate furnished in sheet, strip, small diameter rods and plate. Abrasion resistance, medium; max cont serv temp, 250 F; is slow burning; flexibility, medium; dielectric str, 250 volts per mil, inst. (for ¼-in. thickness); ts, 15,500 psi; comp str, 41,000 psi; flex str, 20,000 psi; moisture absorption, medium; produced only in natural color; sp gr, 1.35; is opaque; machinability, fair. For small gears and fabricated insulating parts requiring uniform strength.

Grade RGN-30: Same general characteristics and properties as RN-30 except that it has been dimensionally stabilized for use in gears.

Grade XX: Phenolic laminated paper; thermosetting; furnished in laminated form and in rods or tubes; can be highly polished; dielectric str, 500 volts per mil; ts 12,000 psi; heat resistant to 300 F; available in natural and black; low moisture absorption. Used for insulation for electrical equipment.

Grade XXXP: Phenol formaldehyde thermosetting sheets; abrasion resistance, high; max cont serv temp, 225 F; flex str, (ASTM D 650-42T), 17,500 psi; dielectric str, 710 volts per mil; ts 13,500 psi; produced in natural and black colors; moisture absorption, low; sp gr, 1.35; is opaque; machinability, fair. For punched parts in radio transmitter and receiving equipment.

Grade XXP: Laminated phenolic, paper base, furnished in sheet form. Abrasion resistance, high; chemical resistance, poor; max cont serv temp, 225 F; is slow burning; flexibility, medium; dielectric str, 650 volts per mil in 1/16 in. thickness; ts, 8000 psi; comp str, 25,000 psi; flex str, 17,500 psi; moisture absorption, low; produced in natural and black colors; sp gr, 1.36; is opaque; machinability, good. For punched parts which are to be used in applications where moisture resistance is a prime requirement.

Grade XP: Laminated paper base phenolic; furnished in sheet form. Abrasion resistance, high; chemical resistance, poor; max cont serv temp, 200 F; is slow burning; flexibility, high; dielectric str, 700 volts per mil in 1/16 in. thickness; ts, 8000 psi; comp str, 22,000 psi; flex str, 17,000 psi; moisture absorption, medium; available in natural, chocolate brown, and black colors; sp gr, 1.36; is opaque; machinability, fair; for punched parts to be used in electrical insulation for automotive ignition or 110-volt apparatus.

Grade YN-25: A nylon-phenolic laminate furnished in sheet, strip, rods, tubes and plate. Abrasion resistance, medium; max cont serv temp. 300 F; is noninflammable; flexibility, high; dielectric str, 350 volts per mil, inst; ts, 6000 psi; comp str, 30,000 psi; flex str, 10,000 psi; moisture absorption, very low; produced only in natural color; is shatterproof; sp gr, 1.17; is opaque; machinability, good; Rockwell hardness, M100. For radio and electronic insulation, etc.

FORTICEL (Cellulose propionate plastics)—Celanese Corp. of America, Plastics Div., New York 16.

Available in granules for injection and compression molding. Abrasion resistance medium; wide solubility in organic solvents; max cont serv temp depends upon use and formula; flexural str, 4800-10,000 psi (ASTM D 650-42T); dielectric str, 370-425 volts per mil (⅛-in. thickness); ts, 2800-6000 psi; impact str, .08-11.4 ft lb (Izod); available in colors; transparent, translucent and opaque; moisture absorption, low; sp gr, 1.17-1.22; machinability, good. For vacuum cleaner parts, housings, radio cabinets, etc.

FRANKITE (Alloy irons) — Frank Foundries Corp., Moline, Ill.

E-212; low-carbon electric furnace iron; pressure-resistant and long-wearing dense grain in heavy sections. For hydraulic bodies, refrigerator parts, compressor cylinders, etc. Good machinability.

E-450; Ni 14, Cr 2, Cu 6, electric furnace Ni-Resist. Has corrosion resistance, heat resistance to 1500 F; fair machinability.

E-604; Ni 4½, Cr 1½, electric furnace Ni-Hard white iron. Combats corrosion. For mixer blades, ash chutes, scrapers, etc.

E-830-N; Cr 30, Ni 3, low carbon; heat-resistant. For continuous oven kilns, cement kiln cooler parts, furnace supports, etc.

FRANKLIN (Hard vulcanized fiber)—Franklin Fibre-Lamitex Corp., Wilmington, Del.

Thermosetting; zinc-chloride treated paper; furnished in sheet, rods, tubes and screw machine parts. Abrasion resistance, high; chemical resistance, good; dielectric strength (volts per mil. inst.), 200-300; ts, 5000-6500 psi; produced in red, gray, black and white colors; moisture absorption, medium; weight 0.8 lb per cu in.; is opaque; machinability, good.

FRONTIER (Bronzes)—Frontier Bronze Corp., Niagara Falls, N. Y.

40 E; in sand castings and ingot form; not heat treated; ts, 32,000 psi min; ys, 22,000 psi min; elong. 3-10%. Resists salt water corrosion; abrasion resistance, high; excellent machinability; resistant to hydrostatic pressure; resistance to shock and impact, high. For high strength parts.

No. 5 aluminum bronze; in castings; ts, 60-95,000 psi; comp str, 22-65,000; ductility, good: Bhn, untreated, 120; heat-treated, 130-200. For parts where resistance to shock, fatigue and wear are essential.

No. 11 nickel bronze; good bearing qualities with positive lubrication; wear-resistant; heat-treated, ts, 60-70,000 psi; ys, 38-45,000; elong, 15-20 per cent; bhn, 160.

FURATONE (Resins)—Irvington Varnish & Insulator Co., Irvington, N. J.

Synthetic resins based on furane, which are used as compounding, laminating, and bonding resins and in protective coatings of high acid and alkali resistance. Also used as the bond in molding powders. Supplied in liquid to solid states as required.

FV (Radio spaghetti)—Irvington Varnish & Insulator Co., Irvington, N. J.

Flexible lacquered tubing for electrical insulation; meets ASTM and VTA standards for grade A-2 flexible varnished tubing; resistant to aging, oil, moisture, acid vapors, weak alkalies. Obtainable in five colors.

FYBEROID (Fish paper) — Wilmington Fibre Specialty Co., Wilmington 99, Del.

Furnished in sheet form, for machining or stamping into parts; dielectric str, 200-400 volts per mil; ts, 5000-8000 psi; flexible; abrasion and corrosion-resistant. Used for insulation on motors, generators, automotive ignition starters, etc.

FYBR-TECH (Plywood)—Technical Ply-Woods, Chicago 1.

Thermosetting; furnished in sheet form for simple molding. Abrasion resistance, excellent; resists corrosion, repels termites; heat resistance, good; bonded at 350 F; flexibility, good; high dielectric strength; tensile and compressive strengths, good to excellent depending on construction; moisture absorption, fair; excellent when treated. Available in stock colors, gray, red, green or white; pigmented to match in large quantities; machinability, excellent.

G

G ALLOY (Lead-base bearing alloy)—American Smelting & Refining Co., New York.

Furnished in ingots for spinning and mold casting. Resists heat to 300 F; abrasion resistance, high; ts, 10,000 psi; comp str, 15,000 psi; good bearing properties; bhn, untreated, 22. Used for bearing applications. Is being widely substituted for tin babbitts.

GARIT (Cold-molded plastics) — Garfield Mfg. Co., Garfield, N. J.

Thermosetting, corrosion resistant; dielectric strength, 50-60 volts per mil; ts, 1200 psi; heat resistance, 500 F; moisture absorption, 2%; noninflammable; comp str, 7500 psi. Used for molded insulation for electrical equipment.

GASKOFELT (Felt-rubber material) — Western Felt Works, Chicago.

Compact combination of felt with an oil-resistant rubber compound of great density and high tensile strength. Used for gasketing in connection with oil, steam, hot or cold water; temperatures up to 250 F; pressures up to 225 lb.

G-E (Silicone rubber) — General Electric Co., Chemical Dept., Pittsfield, Mass.

These rubbers have exceptionally high heat resistance and do not adhere to or corrode metal contacting surfaces. At low temperatures they do not increase in hardness or become stiff. Type 12,600; sp gr, 1.75; hardness, durometer Shore A, 40; compression set, at 150 C, 30%; ts, 200 psi; elong, 225%. Type 12,601; sp gr, 2.04; hardness, durometer Shore A, 60; compression set, at 150 C, 45%; ts 450 psi; elong, 150%; Type 12,602; sp gr, 1.40; hardness, durometer Shore A, 70; compression set at 150 C 35%; ts, 650 psi; elong, 110%. Type 12,603; sp gr, 1.50; hardness, durometer Shore A, 80; compression set at 150 C, 30%; ts 500 psi; elong, 100%.

GEMFLEX (Thermoplastic plastics) — Gemloid Corp., Elmhurst, L. I., N. Y.

Vinyl chloride acetate, furnished in rods and tubes, and for molding and extruding into parts. Has excellent resistance to acids, alkalies, oils and waters. Max cont serv temp, 150-160 F; dielectric str, approximately 1100 volts per mil; ts, 2500 psi; moisture absorption, low; transparent, translucent and opaque; strong and tough at lower than freezing temperatures; high fatigue strength; unusual flexibility. For insulating, gasketing, etc.

GEMLITE (Acrylic thermoplastic plastics)—Gemloid Corp., Elmhurst, L. I., N. Y.

Furnished in laminated sheet, rods and tubes for injection molding; corrosion and impact-resistant; high tensile and dielectric strengths; max cont serv temp, 150-160 F; noninflammable; takes high polish; transparent, opaque and translucent; available in colors; moisture absorption, low; good machinability. Used for handles, knobs, nameplates, dials, etc.

GEMLOID (Sheet plastics) — Gemloid Corp., Elmhurst, L. I., N. Y.

Thermoplastic and thermosetting material, furnished in sheet and laminated form for stamping into parts; abrasion resistance, medium; heat resistance for thermoplastics is 175 F and for thermosetting type, 400 F; ts, 4000-6000 psi; moisture absorption, low; noninflammable. Used for replacing metal nameplates.

GEMPCO (Metallic friction materials)—General Metals Powder Co., Akron, O.

Friction materials of powdered copper and other powdered metallic and nonmetallic ingredients, blended, compressed to shape and heat-treated. Riveted or brazed to metal backing. Thicknesses from 0.012-in. up. For clutch disks, clutch and brake linings.

GENERAL (Aluminum oxide)—General Ceramics & Steatite Corp., Keasbey, N. J.

Furnished in rods, tubes and plates. Abrasion resistance, high; noninflammable; transverse str, 29,000 psi; moisture absorption, low;

available in white, opaque. For use where high strength for insulation is required.

GENERAL (Rubber)—The General Tire & Rubber Co., Mechanical Goods Div., Wabash, Ind.

All types of rubber, molded and extruded for household, industrial and automotive applications. For gaskets, grommets, bushings, rings, pump diaphragms, washers, casters, extruded seals, channel strips, glass-run channels, fan belts, etc.

GENEX (Arc welding electrode)—Metal & Thermit Corp., New York 5.

For general purpose fabrication. Weld deposit; Ts, 68-80,000 psi; ys, 53,000-65,000 psi; elong in 2 in., 17-25%.

GEON (Polyvinyl chloride thermoplastic)—B. F. Goodrich Chemical Co., Cleveland 15.

Furnished in granules, powders and latices. For injection and compression molding, extruding, calendering and coating. Excellent chemical resistance except for ketones and chlorinated hydrocarbons. Max cont serv temp, 150 F; dielectric str, 400-2000 volts per mil; ts, to 3500 psi; produced in all NEMA colors, transparent, translucent and opaque; moisture absorption, low; sp gr, 1.3. For various applications such as electrical insulation, beverage tubing, gasket and packing material, automotive body or refrigerator strips, etc.

GIBSILOY (Powder metal)—Gibson Electric Co., Pittsburgh 21, Pa.

Electrical contract materials made by process of powder metallurgy. Several compositions available for each type of material; providing in varying degrees combinations of properties such as low and constant contact resistance, high electrical and thermal conductivity, hardness, resistance to deformation and wear, resistance to erosion from arcing and resistance to sticking.

A; silver-nickel; low contact resistance, high ductility, high current carrying capacity. Hardness, cold worked, up to Rockwell B 60; in contact rivets, disks, screws, stamped or coined shapes, sheets or wire. For circuit breaker main contacts, contactors, relays, disconnect switches, instruments, slidewire contacts.

NW; silver-nickel-tungsten; combines current carrying capacity with medium current interrupting capacity; in contact disks or other stamped shapes. For contactors, switches, relays, and d-c vibrators.

C; silver-graphite; highly nonwelding, low contact resistance; in contact disks, stamped on molded shapes. For circuit breakers, and sliding contacts generally.

M; silver-molybdenum; heavy current interrupting ability, resists erosion from arcing; hardness up to Rockwell B 80; in individually molded shapes. For circuit breaker arcing tips; contactors operated under oil.

W; silver tungsten; heavy current interrupting ability, highly resistant to erosion from arcing, high conductivity; hardness up to Rockwell B 100; in individually molded shapes. Some grades for contacts in small circuit breakers such as household breakers. Other grades for heavy-duty circuit breaker arcing tips operating in air.

GLACIER (Bearing babbitt)—Glacier Metal Co., Richmond, Va.

Antifriction metal; sold in ingots; recommended pouring temperature, 600 F; bhn, 24.1; load to reduce height of test piece by 0.001-in., 4599 psi; load required to compress test piece 50% of original height, 26,-118 psi; sp gr, 9.976; wt, lb per cu in., 0.359.

Genuine Sovereign babbitt; ys, 5 tons per sq in., elong in 2 in., 16.7%; bhn, 28.4; load to reduce height of test piece by 0.001-in., 9800 psi; sp gr, 7.327; wt, lb per cu in. 0.263; pouring temperature, 800 F. For bearings.

GLASTIC (Thermosetting polyester plastics)—Laminated Plastics Inc., Cleveland 12.

Furnished in laminated sheets and molded shapes.

Grade S; Flex str, 34,000 psi; modulus of elasticity, 1,800,000; impact str (Izod), 22.2 ft-lb; ts, 24,500 psi; comp str, 16,500 psi; sp gr, 1.61; hardness number, 90 Rockwell M; dielectric str, 300-500 volts per mil; good resistance to acetone, moderate acids, alkalies, etc.

Grade MF; Flex str, 20,500 psi; modulus of elasticity, 1,000,000; impact str (Izod), 21 ft-lb; ts, 18,000 psi; comp str, 15,500 psi; sp gr, 1.55; hardness number, 90 Rockwell M; dielectric str, 300-500 volts per mil; good resistance to acetone, moderate acids, alkalies, etc.

Grade WU; Flex str, 96,500 psi; modulus of elasticity, 4,800,000; impact str, (Izod), 46 ft-lb; ts, 76,000 psi; comp str, 42,500 psi; hardness, 90 Rockwell M; sp gr, 1.8; dielectric str, 300-500 volts per mil. Good resistance to outdoor exposure, hydrocarbons, moderate acids, chrome-plating acids, nickel-plating acids, acetone, and mild alkali cleaning solutions.

Grade W; Flex str, 52,000 psi; modulus of elasticity, 2,900,000 psi; impact str (Izod), 25.4 ft-lb; ts, 44,500 psi; comp str, 24,000 psi; hardness, 90 Rockwell M; sp gr, 1.8; dielectric str, 300-500 volts per mil; good resistance to outdoor exposure, hydrocarbons, moderate acids, chrome and nickel-plating acids, acetones, and mild alkali cleaning solutions.

GLOBE (Seamless steel tubing) — Globe Steel Tube Co., Milwaukee 4.

Carbon steel tubes in low and medium carbon for mechanical purposes. Furnished hot-finished and cold-drawn to wide range of sizes; also annealed or cold-drawn stress relieved to higher physicals for strength and machinability.

Carbon seamless steel pressure tubing in low and medium carbon for boiler, condenser, heat exchanger tubes, straight and formed.

Alloy seamless steel tubing in low and medium carbon in SAE and NE grades for mechanical and aircraft tubing; in regular and magnaflux quality. Intermediate alloys such as 5-9% Chrome Moly for petroleum industry.

Stainless seamless tubing in austenitic 18-8 types. Low carbon Type 304, stabilized Types 321 and 347 for welding and maximum corrosion and heat resistance; for dairy, food, chemical industries. Types 329 and 443 for corrosion resistance in specific applications in chemical and textile fields. Straight chrome Types 410 for heat treating where high tensile and toughness with mild corrosion resistance is required. Type 430 for chemical service, especially nitric acid; also for heat resistance applications. Type 446 for high temperature service where load carrying requirements are not severe; good resistance to high sulphur atmospheres. Used where nickel bearing grades are objectionable. For further data on properties and applications, see "Stainless Steels" listing at end of this section.

GLOBEIRON (Seamless ingot iron tubing)—Globe Steel Tube Co., Milwaukee 4.

High purity ingot iron in seamless tubing providing high magnetic permeability for electrical purposes. Offers some corrosion resistance in certain special cases because it approaches pure iron.

GLOWELD (Stainless steel welded tubing) — Globe Steel Tube Co., Milwaukee 4.

Stainless welded tubing in many AISI types. For property and application data, see "Stainless Steels" listing at end of this section.

GLYCO (Babbitt)—Joseph T. Ryerson & Son Inc,. Chicago 80.

Turbo-Glyco; for bearings for high-speed, heavy duty; avg bhn, 30.

Marine Glyco; for bearings for electric motor and marine work; avg bhn 27.

Standard Glyco; free flowing, general purpose babbitt; avg bhn, 24.

Heavy pressure mill Glyco; high resistance to crushing loads; high bearing temperatures, avg bhn, 23.

Transmission Glyco; for line shafting and transmission work; avg bhn, 22.

GOLD ANCHOR (Drill rod) — Anchor Drawn Steel Co., Latrobe, Pa.

C 0.70, W 18, Cr 4, V 1.00, Si 0.25, Mn 0.25. Oil or air-quenched and double-tempered; hardness, rockwell C, 67 max; magnetic; weldability, poor; abrasion resistance, high; max cont serv temp, 1200 F. For dies, high-temperature springs, dowel pins, punches, taps, drills, reamers, dies, etc.

GRAC (Lead-base graphitized babbitt)—Graphitized Alloys Corp., New York 7.

Contains approximately 10% tin, 15% antimony and smaller amounts of cadmium, copper and arsenic with the balance lead. Furnished in pig or ingot. Compressive str at room temperature, 7900 psi; ys, 15,-000 psi; bhn at room temperature, approximately 27; is nonmagnetic; machinability, good; max cont serv temp, 150 F; abrasion resistance, high. Casting temperature, 800-900 F. Used for bearings in rolling mills, internal combustion engines, diesel engines, freight car axles, turbine pumps, high lift pumps, high speed locomotives and rock crushers.

GRAKONE (Rubber)—Graton & Knight Co., Worcester 4, Mass.

Oil-resistant rubber furnished in molded sheets. Abrasion resistance, high; resistant to all petroleum products, vegetable oils and fats, alcohols, dilute acids and alkalies, etc. Max cont serv temp, 212 F; flexibility, high; dielectric str, at 60 cycles, 19.5 volts per mil; ts, 4000 psi max; elongation, 100 to 800; moisture absorption, low; produced in black; sp gr, 1.15-1.35; opaque; hardness, Shore A, 30-100. Used as sealing element for reciprocating, static or revolving shafts.

GRAMIX (Porous metals)—United States Graphite Co., Saginaw, Mich.

No. 81; sintered bronze; in porous metal bearings and mechanical shapes; ts, 15,000 psi; compressive force to cause 0.001-in. permanent set, 10,000 psi; apparent density, 6.4-6.6 grams per cu-cm; oil absorption (by volume), 20-30%; coef of thermal expansion (70-200 F), .00000934 in./in./degree F.

No. 86; sintered iron; furnished as porous metal bearings and mechanical shapes; ts, 20,000 psi; compressive force to cause 0.001-in. permanent set, 16,000 psi; apparent density, 5.8-6.1 grams per cu cm; oil absorption (by volume), 15-20 per cent; coef of thermal expansion, (70-200 F), .0000071 in./in./degree F.

GRAPH-AL (Alloy steel)—Timken Steel & Tube Div., Timken Roller Bearing Co., Canton 6, Ohio.

C 1.50 avg, Si 0.30 max, Mn 0.30 max, P and S 0.25 max, Al 0.12-0.20; furnished in rough bars or billets, finished rods or bars, straight and coiled strip, wire, sheet, plate and forgings; for machining, hot and cold working, brazing, and arc, gas and resistance welding. For annealing, normalize 1700 F; furnace-cool from 1380-1150 F; quench 1450-1500 F into brine. In annealed state: Ts, 105,000 psi; ys, 53,000 psi; elong in 2 in., 15.5 per cent; impact str, 120+ ft-lb (Izod); quenched hardness, 67-68 rockwell C. Weldability, good; abrasion resistance, high. For applications requiring high impact resistance such as swaging rolls, etc.

GRAPHALLOY (Carbon-graphite metallized materials)—Graphite Metallizing Corp., Yonkers 3, N. Y.

Babbitt; carbon-graphite metallized (impregnated) with babbitt; furnished in rough bars, finished rods and bars, for machining. In untreated state: Ts, approx 5000 psi; comp str, 18,400-23,100 psi; hardness, 45-61 (Shore scleroscope); nonmagnetic; max cont serv temp, 300 F. For oilless bushings.

Copper; carbon-graphite metallized (impregnated) with copper; furnished in rough bars, finished rods and bars, for machining. In untreated state: Ts, 5000 psi; comp str, 19,-200-24,500 psi; hardness, 48-63 (Shore scleroscope); nonmagnetic; max cont serv temp, 700 F. For oilless bushings and motor brushes.

Cadmium; carbon-graphite metallized (impregnated) with cadmium; furnished in rough bars, finished rods and bars, for machining. In untreated state: Ts, 4000-5000 psi; comp str, 18,000-20,000 psi; hardness, 45-61 (Shore scleroscope); max cont serv temp, 250 F. For oilless bushings and electric contacts.

GRAPHICELL (Porous graphite)—National Carbon Co., Inc., New York 17.

Available in standard and special shapes including cylinders, blocks, open or blind-end tubes, and rods. Uniform high porosity and small pore size; easily machined and fabricated into practically any shape; resistant to acids and alkalies; not subject to fracture and spalling from thermal shock; high electrical conductivity. For filtration, gas dispersion, etc.

GRAPHITAR (Carbon-graphite)—United States Graphite Co., Saginaw, Mich.

Used for bearings, thrust washers, seals, rotor vanes, etc., made in several grades of which the following is typical. Comp str, 22,000 psi; apparent density (gr per cu cm), 1.77; transverse breaking strength, 10,500 psi; scleroscope hardness, 85; coef of thermal expansion, 75-620 F (in./in./degree F). 0.0000015.

GRAPH—M.N.S. (Alloy steel)—Timken Steel & Tube Div., The Timken Roller Bearing Co., Canton, O.

C 1.5, Mn 1.25, P 0.025 max, S 0.025 max, Si 1, Ni 1.75, Mo 0.5, Cr 0.5; in hot-rolled bars and billets, finished rods and bars, wire, sheets, strip, plates and forgings. Has high resistance to abrasion, and nonscuffing properties when cold forming metal; ts, annealed, 135,000 psi; medium ductility. Weldability, good; bhn, annealed, 241; heat-treated 682. Used for various types of machine parts, having light walls and non-uniform sections as well as cold-working dies and tools.

GRAPH-MO (Alloy steel)—Timken Steel & Tube Div., The Timken Roller Bearing Co., Canton, Ohio.

C 1.5, Si 0.8, Mn 0.4, P and S 0.025 max, Mo 0.25; in hot-rolled bars or billets, finished rods or bars, wire, strips, sheets, plates and forgings. Has high abrasion resistance; ts, 85,000 psi, min; medium ductility; fair bearing properties; good weldability; good nonscuffing properties; bhn, annealed, 197, heat-treated, 745. Used for jigs, fixtures, dies and tools. All parts requiring resistance to wear and nonscuffing properties.

GRAPHO (Babbitt metal)—Lehigh Babbitt Co., Allentown, Pa.

Babbitt metal of different grades, mixed with graphite; can be poured as regular metal without losing graphite content. Mechanical properties similar to those of other babbitt metals. For bearings.

GRAPH-SIL (Alloy steel)—Timken Steel & Tube Div., The Timken Roller Bearing Co., Canton, Ohio.

C 1.5, Si 0.9-1, Mn 0.5 max, P and S .025 max; in hot-rolled bars or billets, finished rods or bars, seamless tubing, wire, sheets, strips, plates and forgings. Ts, 97,500 psi; abrasion resistance, high; medium ductility; ys, 56,000 psi; elong in 2 in., 25.5 per cent; bhn, 187; excellent machining and nonscuffing properties; good weldability. For use as cylinder liners, pump liners, brake drums, and tools and dies.

GRAPH-TUNG (Alloy steel)—Timken Steel & Tube Div., Timken Roller Bearing Co., Canton 6, Ohio.

C 1.50 avg, Si 0.65 avg, Mn 0.50 max, Mo 0.50 avg, W 2.80 avg; furnished in rough bars or billets, finished rods or bars, straight strip, wire, sheet, plate, and forgings; for machining, hot and cold working, brazing, and arc, gas and resistance welding. Weldability, good; abrasion resistance, high. For parts requiring maximum wear resistance.

GRATON & KNIGHT LEATHERS (Mechanical leathers)—Graton & Knight Co., Worcester 4, Mass.

Vegetable, mineral or combination tan leathers furnished for molding. Abrasion resistance, high; is resistant to most petroleum products, vegetable and animal fats and oils, and many organic solvents. Max cont serv temp, 130-190 F depending on moisture and service condition; inflammable; flexibility, high; ts, 5000 psi avg; elongation, up to 50%; moisture absorption, high; available in natural color; sp gr, 0.95-0.99. For hydraulic, pneumatic and vacuum sealing members for either rotating, reciprocating or static machine members. Material can be made to possess an extremely high coefficient of friction.

GUMMON (Cold-molded thermosetting plastics)—Garfield Mfg. Co., Garfield, N. J.

Black, cold-molded, corrosion and heat-resistant (450 F); high dielectric strength; high polish; resistant to hot oil. Will not shrink, crack, warp or deteriorate with age; takes high polish; noninflammable. Used for insulated parts, etc.

GUNITE (Cast irons and cast steels)—Gunite Foundries Corp., Rockford, Ill.

A; processed cast iron, in untreated state; Ts, 40,000 psi; bhn, 223.

A-1; processed cast iron. Oil quench for brinell over 400. In untreated state: Ts, 40,000 psi; bhn, 223.

B-1; processed cast iron. Oil quench for high hardness. In untreated state: Ts, 50,000 psi; bhn, 255.

C; processed cast iron. In untreated state: Ts, 35,000 psi; bhn, 212.

D; processed cast iron. Oil-quench for high hardness. In untreated state: Ts, 45,000 psi; bhn, 248.

E; processed cast iron. Oil-quench for high hardness. In untreated state: Ts, 45,000 psi; bhn, 229.

E-1; processed cast iron. Oil-quench for high hardness. In untreated state: Ts, 40,000 psi; bhn, 223.

F; processed cast iron. Oil-quench for high hardness. In untreated state: Ts, 50,000 psi; bhn, 262.

R; processed cast iron. Oil-quench for high hardness. In untreated state: Ts, 50,000 psi; bhn, 269.

S; processed cast iron. Oil-quench for high hardness. In untreated state: Ts, 45,000 psi; bhn, 248.

Also standard ASTM grade malleable irons as follows:

35018; castings. In annealed state: Ts, 53,000 psi; ys, 35,000 psi; elong in 2 in., 18 per cent min; bhn, 130.

32510; malleable castings. In annealed state: Ts, 50,000 psi; ys, 32,500 psi; elong in 2 in., 10 per cent min.

50004; pearlitic malleable iron castings. In heat-treated state: Ts, 80,000 psi; ys, 50,000 psi; elong in 2 in., 4 per cent min; bhn, 207.

Cast steels available as follows:

30-70; in heat-treated state: Ts, 70,000 psi min; ys, 35,000 psi min; elong in 2 in., 24 per cent min; bhn, 150.

45-80; in heat-treated state: Ts, 80,000 psi min; ys, 40,000 psi min; elong in 2 in., 17 per cent min; bhn, 170.

32X105; in heat-treated state: Ts, 105,000 psi min; ys, 85,000 psi min.; elong in 2 in., 15 per cent min; bhn, 217.

H

HANDY FLUX (Welding rod)—Handy & Harman, New York 7.

For brazing steel, stainless steel, Monel metal, nickel, copper, beryllium - copper, brass, bronze, aluminum-bronze and various other ferrous and nonferrous metals and alloys. Liquid and active at 1100 F.

HARDEX (Arc welding electrode)—Metal & Thermit Corp., New York 5.

A series comprising Nos. 20, 25, 45 and 60, for hard facing drills, dippers, hammers, rollers, crushers, wobblers, sprockets, spindles, impellers, idlers, scraper blades, wearing plates, etc.; with characteristics such as high corrosion resistance, high abrasion resistance and good bearing qualities.

HARDWELD (Welding electrode)—Lincoln Electric Co., Cleveland.

Type 100; high-carbon arc welding electrode having bhn of 225-488. Provides dense, tough surface of moderate hardness to enable various steel parts to resist shock and abrasion; for locomotive or crane tire flanges, etc.

Type 50; medium-carbon steel electrode for building up steel parts and surfaces. Deposit has considerable resistance to deformation and wear, and is machinable at slow speed. Coating stabilizes the arc and permits deposition of a tough, dense medium carbon steel. Hardness, deposited on straight-carbon steel and allowed to cool naturally, 20 to 35 Rockwell C.

HARDY (Metal powders)—Charles Hardy Inc., New York 17.

Metal powders of various kinds including aluminum, brass, copper, iron, tungsten, tungsten carbide, manganese, nickel, etc.; available commercially; when compressed into parts give physical properties approaching those of metals or alloys produced by melting and casting, and some properties unattainable by other means. Company provides laboratory and engineering advisory service.

HARDYNE (Permanent magnet powder)—Charles Hardy Inc., New York 17.

May be pressed to form complex shapes obtainable by powder metallurgy; parts so produced require no sintering. Among its uses are speedometer, pickup and instrument magnets, magnetic recording tape, etc.

HARRIS 80-10-10 (Copper-tin alloy)—Arthur Harris & Co., Chicago 7.

Cu 80, Sn 10, Pb 10; furnished as sand castings. Used for bearings and pressure castings.

HARRIS SILENTBLOC (Metal-rubber composition)—Harris Products Co., Cleveland, O.

Metal combined with natural or synthetic rubber for mountings and bearings. Used for machine mounts to control vibration, oscillating or torque joints, spring-shackle bushings. Applications include automotive, farm machinery, aircraft, railroad, and electrical equipment, etc.

HARVEL (Insulating varnishes)—Irvington Varnish & Insulator Co., Irvington, N. J.

Special phenol-formaldehyde, polymerization type varnishes with exceptional penetrating power, excellent electrical properties; noncorrosive; unusual resistance to acids, dilute alkalies, moisture, lubricating and transformer oil; save baking time required; harden by polymerization rather than oxidation and cure to infusible nonthermoplastic state. For use with any type of insulation. Also oleoresinous types in clear and black, air-drying, baking.

Oil stop; oilproof, waterproof, heat-resistant, phenol-aldehyde used in splicing electrical cables; to seal and insulate electrical coils. Applied as a viscous liquid, it hardens by polymerization to an infusible, nonthermoplastic state; adheres to rubber, oil-impregnated paper, varnished cambric, fiber, bakelite and copper.

HASCROME (Hard facing rods)—Haynes Stellite Co., Kokomo, Ind.

Cr 10-14, C 0.80-1.20, Mn 3-5, Fe balance; welding rod for hard facing parts subject to abrasion and impact, and castings to resist abrasion and impact.

HASKELITE (Plywood)—Haskelite Mfg. Corp., Grand Rapids 2, Mich.

Resin-bonded plywood; light weight; high strength; elastic; hardenable into desired forms and shapes. Used for airplanes, buses, railways, radio cabinets and speakers, passenger cars, etc.

HASTELLOY (Nickel-base alloys)—Haynes Stellite Co., Kokomo, Ind.

A; C 0.02-0.12, Mo 17-21, Fe 17-21, Ni balance. Furnished in rough bars, finished rods or bars, straight strip, welded tubing, wire, sheet, plate, and as sand castings; for machining, hot working, stamping, drawing and arc, gas and resistance welding. As cast: Ts, 69-78,000 psi; ys, 42,500-45,000 psi; elong, 8-12 per cent; bhn, 155-200; impact str, 25-35 ft-lb (Izod). Rolled, annealed: Ts, 110-120,000 psi; ys, 47-52,000 psi; elong, 40-48 per cent; bhn, 200-215. For all types of chemical equipment, coils, vessels, heat exchangers, etc.

B; Mo 24-32, Fe 3-7, C 0.02-0.12, Ni balance. Furnished in rough bars, finished rods or bars, straight strip, welded tubing, wire sheet, plate and castings; for machining, hot working, drawing, brazing, and arc, gas and resistance welding. As cast: Ts, 75-82,000 psi; ys, 55-57,000 psi; elong, 6-9 per cent; hardness, rockwell B, 92-99. Rolled-annealed: Ts, 130-140,000 psi; ys, 60-65,000 psi; elong, 40-45 per cent; hardness, rockwell B, 96-100; sp gr, 9.24; abrasion resistance, medium. For all types of chemical equipment and turbine blading.

C; Mo 14-19, Fe 4-8, C 0.04-0.15, Cr 12-16, W 3-5.5, Ni balance. Furnished in rough bars, finished rods or bars, welded tubing, wire, sheet, plate and castings; for machining, hot working, stamping, drawing, brazing and arc, gas and resistance welding. As cast: Ts, 72-80,000 psi; ys, 45-48,000 psi; elong in 2 in., 10-15 per cent; hardness, rockwell B, 89-97. Rolled annealed: Ts, 115-128,000 psi; ys, 55-65,000 psi; elong in 2 in., 25-50; hardness, rockwell C, 50-55. Sp gr, 8.94; max cont. serv. temp, 2000 F; abrasion resistance, medium. For all types of chemical equipment, also exhaust gas systems for aircraft, heat-treat furnace parts, and carburizing furnace parts.

D; Si 11, Cu 2-5, Al 1 max, Ni balance. Furnished as castings and cast welding rod. In untreated state: Ts, 36-40,500 psi; hardness, rockwell C, 50-55; sp gr, 7.80; nonmagnetic; max cont. serv. temp, 1200 F; abrasion resistance, high. For equipment for handling hot sulphuric acid, also for wear parts such as sleeves, bushings, etc.

HAVEG 41, 48, 60 (Furane thermosetting plastics)—Haveg Corp., Newark 23, Del.

Furnished in sheets, rods and tubes, for compression molding and casting. Abrasion resistance, medium; resistant to acids, alkalies and solvents; max cont serv temp, 300 F. Principally used for process equipment such as tanks, valves, pumps, pipe, fans, fume ducts, etc.

HAYNES STELLITE (Co-Cr-W welding rods and castings)—Haynes Stellite Co., Kokomo, Ind.

1; Cr 28-34, W 11-15, Co balance. Cast hardfacing rod. In untreated state: Ts, 47,000 psi; comp str, 256,000 psi; hardness, rockwell C, 54 (gas welded) and 45 (arc welded); sp gr, 8.59; nonmagnetic; max cont. serv. temp, 2000 F; abrasion resistance, high. For hardfacing farm implements, screw conveyors, mixing machine plows, bed plates, guides, cams, scrapers, stripping knives, and other applications requiring resistance to heat, abrasion and corrosion or combinations of these, and where only moderate shock is encountered.

6; Cr 25-31, W 3-6, Co balance. Hardfacing rod. Ts, 105,000 psi; comp str, 220,000 psi; elong in 2 in., 1 per cent; hardness, rockwell C, 40-46; sp gr, 8.38; nonmagnetic; weldability, good; max cont. serv. temp, 2000 F. For valves, disk gates and plugs for steam, gas H_2O, knives, strippers, rolls, shafts, sleeves, etc., where heat, abrasion and corrosion resistance are required, and where more ductility and shock resistance is needed than that of Alloy No. 1.

12; Cr 26-32, W 6-10, Co balance. Hardfacing rod and castings. In untreated state: Ts, 76,000 psi; comp str, 193,000 psi; hardness, rockwell C, as cast, 46-58, as deposited, gas, 48; sp gr, 8.40; nonmagnetic; max cont. serv. temp, 2000 F. For guides, hammers and other applications similar to those given for Nos. 1 and 6, where higher strength and abrasion resistance is required.

21; C 0.20-0.35, Cr 25-30, Ni 1.50-3.5, Mo 4.5-6.5, Fe 2 max. Furnished in sheets and sand and precision castings, for hot working, brazing and arc, gas and resistance welding. In untreated state: Ts, 101,300 psi; ys, 82,300 psi; elong in 2 in., 8.2 per cent; hardness, rockwell C, 28-32; sp gr, 8.30; nonmagnetic; max cont. serv. temp, 2000 F; abrasion resistance, high; good long-time properties at elevated temperatures. Endurance strength in alternate bending at 120 cycles per second at 10^8 cycles, room temp, 35-40,000 psi; at 1200 F, 44,000 psi; and at 1500 F, 33,000 psi. For turbine blading, exhaust systems for aircraft and other high-temperature applications.

23; C 0.35-0.50, Cr 23-29, Ni 1.50 max, W 4-7, Fe 2 max, Co balance. Furnished in sheets and castings, for hot working, brazing arc, gas and resistance welding. In untreated state: Ts, 105,400 psi; ys, 58,400 psi; elong in 2 in., 7 per cent; hardness, rockwell C, 28-32; sp gr, 8.54; nonmagnetic; resists corrosion caused by high-temperature oxidation and exhaust gases; max cont. serv. temp, 2000 F; abrasion resistance, medium. For turbine blading and other high-temperature applications. Material has good long-time properties at elevated temperatures.

27; C 0.35-0.50, Cr 23-29, Mo 5-7, Fe 2 max, Co 30 min, Ni balance. Furnished in sheet and castings, for hot working, brazing, and arc, gas and resistance welding. In untreated state: Ts, 82,500 psi, ys, 46,900 psi, elong in 2 in., 7 per cent; hardness, rockwell C, 17-22; sp gr, 8.21; nonmagnetic; resists corrosion caused by high-temperature oxidation and exhaust gases; max cont. serv. temp, 2000 F; abrasion resistance medium. Good long-time elevated-temperature properties. Endurance strength in alternate bend at 120 cycles per second at 10^8 cycles, at 1200 F, 41,000 psi; at 1500 F, 38,000 psi. For turbine blading and other high-temperature applications.

30; C 0.35-0.50, Cr 23-29, Ni 13-17, Mo 5-7, Fe 2 max, Co balance. Furnished in sheets and castings, for hot working, brazing and arc, gas and resistance welding. In untreated state: Ts, 100,000 psi; ys, 65,000 psi; elong in 2 in., 6 per cent; hardness, rockwell C, 28-32; sp gr, 8.31; resists corrosion caused by high-temperature oxidation and exhaust gases; max cont. serv. temp, 2000 F; abrasion resistance, high. Excellent long-time properties at elevated temperatures. Endurance strength in alternate bend at 120 cycles per second at 10^8 cycles, at 1200 F, 41,000 psi; at 1500 F, 38,000 psi. For turbine blading and other high-temperature applications.

31; C 0.45-0.60, Cr 23-28, Ni 9-12, W 6-9, Fe 1.50 max. Co balance. Furnished in sheets and castings; for hot working, brazing, and arc, gas and resistance welding. In untreated state: Ts, 101,000 psi; ys, 74,100 psi; elong in 2 in., 11 per cent; sp gr, 8.61; resists corrosion caused by high-temperature oxidation and exhaust gases; max cont. serv. temp, 2000 F; abrasion resistance, high. Excellent long-time properties at elevated temperatures. Endurance strength in alternate bend at 120 cycles per second at 10^8 cycles; at 1200 F, 41,000 psi; at 1500 F, 38,000 psi. For turbine blading, etc.

93; Xe 15-19, Co 4-7, V 0.5-3 Mo 13-17, Fe balance. Cast welding rod; heat to 1950 F and air cool. As cast: Ts, 43,000 psi; comp str, 407,800 psi; hardness, rockwell C, 62 as deposited, gas welded. In heat-treated state: Ts, 34,700 psi; comp str, 285,300 psi; hardness, rockwell C, gas welded, heat treated, 66-67; arc welded, heat treated, 63-64. Suitable for hardfacing where high cold hardness is necessary and corrosion is not an important factor; for applications which tend to grind away a metallic surface, such as dredge pump impellers, cement clinker crusher rolls, etc.

98M2; Cr 27-31, W 16-19, Co balance. Furnished as castings. In untreated state: Ts, 63,000 psi; hardness, rockwell C, 62-64; nonmagnetic; resists corrosion caused by high-temperature oxidation; max cont. serv. temp, 1800 F; abrasion resistance, high. For metal-cutting tools, for cast iron, steels, nonferrous alloys and nonmetallic materials; gages, bushings and special castings requiring resistance to heat, abrasion and corrosion, or combinations of these.

Star-J Metal; Cr 29-34, W 15-19, Co balance. Furnished as castings. In untreated form: Ts, 65,000 psi; hardness, as cast, rockwell C, 58-62; sp gr, 8.76; nonmagnetic; weldability, good; resists corrosion all atmospheric conditions including brine, also 10 per cent boiling HNO_3, boiling acetic and ferric sulphate, and 10 per cent solutions of ferric chlorides; max cont. serv. temp, 2000 F; abrasion resistance, high. For metal cutting tools, gages, valves and seats, bushings, guide rolls, cam followers, and other special castings requiring resistance to heat, abrasion and corrosion, or combinations of these encountering only moderate shock or impact where maximum hardness is required.

HAYSTELLITE (Tungsten carbide welding rod)—Haynes Stellite Co., Kokomo, Ind.

Hard grade; W 90-96, C 3.50-4.50 and Co 0.50-2.00. In untreated state: Hardness, rockwell A, 82-88, as deposited; abrasion resistance, high. For oil well drilling tools, rock bits, farm implements, earth moving equipment and other applications where utmost resistance to abrasion is necessary.

Tough grade; W 79-85, C 3.50-4.50 and Co 8-11. In untreated state: Hardness, rockwell A, 82-88; abrasion resistance, high. For hard setting oil well drilling tools, earth moving equipment, pulverizing hammers, and other applications where abrasion resistance is required.

HECLA (Bronze)—Titan Metal Mfg. Co., Bellefonte, Pa.

Cu 60, Pb 0.80, Sn 0.75; Zn balance. Ts, 60,000 psi; ys, 30,000 psi; elong, 40%; hardness, 55 Rockwell B. Machinability, good; corrosion resistant; good sea-water resistance.

HEMIT (Cold-molded refractory material)—Garfield Mfg. Co., Garfield, N. J.

Heat resistance, 1500-1750 F; low moisture absorption when impregnated; high dielectric strength; noninflammable. Used for interior parts of heating devices, or where a molded part must withstand an arc.

HEPPENSTALL (Chrome - nickel - molybdenum steel)—Heppenstall Co., Pittsburgh.

2 C 30; Ni-Cr-Mo steel; C 0.3. For shafting where high torsional strength is required.

5 H 50; C 0.5; Cr-Mo and V alloy; furnished as die blocks. Material is heat-resistant, abrasion-resistant; has high tensile strength and high ductility. Used for strip mill rolls, etc.

HERCULES (Cellulose acetate flake)—Hercules Powder Co., Wilmington 99, Del.

A thermoplastic material furnished in the form of flake only. Can be fabricated by injection molding, compression molding, extrusion and blow molding. Abrasion resistance, medium; chemical properties, resists weak acids and alkalies; flex str, 2000-13,000 psi; dielectric strength (volts per mil. inst.), 290-365; ts, 3000-8000 psi; impact str (ft-lb, Izod), 0.7-6.0. Produced in full range of brilliant colors including transiucent and transparent color effects; water absorption (24 hr, ⅛ in. thick—%), 1.5-2.9; sp gr, 1.27; machinability, excellent; thermal expsn, (per °C), 10-15 x 10^{-5}; for small motor housings, wire covering, etc.

HERCULITE (Heat-treated plate glass)—Pittsburgh Plate Glass Co., Pittsburgh 19.

Furnished in flat and bent sheets. Corrosion and abrasion resistance, high; heat-resistant to 650 F; flexibility, medium; ts, 29,500 psi; moisture absorption, low; nonflammable; sp gr, 2.52; transparent; highly polished. For use as windows or any glass application requiring unusual strength.

HERCULOY (Silicon bronze)—Revere Copper & Brass Inc., New York 17.

No. 420: Has corrosion resistance of copper and mechanical properties of mild steel. Physical properties depending on hardness; ts, 58-94,000 psi; ys, 22-58,000 psi; elong in 2 in., 60-8%; hardness, Rockwell 60B-93B; conforms to ASTM specifications. Has good cold working properties, excellent hot working properties, fair machinability, good weldability, is excellent for soldering and good for polishing. Used for tanks, pressure vessels (steam pressure not to exceed 125 lb), weatherstrips, forgings, conduits, hydraulic pressure lines, etc.

No. 421; Low-silicon Bronze; has excellent cold working properties, excellent hot working properties, fair machinability, good weldability, is excellent for soldering and fair for polishing. Physical properties depending on hardness; ts, 45-70,000 psi; ys, 15-55,000 psi; elong in 2 in., 60-8%; hardness, Rockwell 60F-80B; conforms to ASTM specifications. Used for cold headed bolts, nuts, screws, lag bolts, hydraulic pressure lines, cable clamps, cotter pins, etc.

HERESITE (Thermosetting phenol-formaldehyde powder)—Heresite & Chemical Co., Manitowoc, Wis.

Synthetic phenol-formaldehyde molding powders having high chemical resistance, with exception of strong alkalies. Max cont serv temp, 300 F; inflammable; flexibility, low; dielectric str, 300 volts per mil; ts, 6000 psi; comp str, 15,000 psi; trans str, 9000 psi; flex str, 9000 psi; elong in 2 in., 0.6%; moisture absorption, low; available in black, brown, red, green and tan; sp gr, 1.3-1.5; Bhn, 30; coef of thermal expansion, 4 x 10^{-5} in./in./degree C. For dials, knobs, gages, insulators, housings, closures, handles, etc.

No. GP-W: Phenol formaldehyde thermosetting plastic furnished in the form of powder for compression and transfer molding. Abrasion resistance, medium; chemical resistance, medium to high for acids—medium to low for caustics; max cont serv temp, 350 F; flex-

ural str, 9000 psi; dielectric str, 350 volts per mil inst; ts, 5000 psi; comp str, 15,000 psi; impact str (Izod), 0.30 lb; produced in black, brown, green and red; moisture absorption, low; sp gr, 1.3-1.4; is opaque; machinability, fair. A general-purpose molding material having excellent finish.

No. M-66: Panel formaldehyde thermosetting plastic furnished in the form of powder for compression molding. Abrasion resistance, medium; chemical resistance, medium; chemical resistance, high for acids—medium to low for caustics; max cont serv temp, 350 F; flexural str, 12,000 psi; dielectric str, 300 volts per mil inst.; ts, 7000 psi; comp str, 10,000 psi; impact str (Izod), 0.36 ft-lb; produced in red, amber and green; moisture absorption, low; sp gr, 1.29; produced transparent; machinability, fair. Provides excellent finish; is used for dairy equipment, hospital equipment, etc.

HEVIMET (Special alloy)—General Electric Co., Chemical Dept., Pittsfield, Mass.

Furnished in the form of sheets and rods produced by powder metallurgy. Abrasion resistance, high; ts, 85,000-118,000 psi; sp gr, 16.8-17.0; machinability, good; hardness, Rockwell 30-40 C; coefficient of thermal expansion, 5.6 x 10^{-6} inch/inch/degree C. An extremely dense and heavy material used for X-ray absorption screens and balancing weights for crankshafts, airscrews, centrifugal clutches, etc.

HIDEN (Laminated plastics)—Parkwood Corp., Wakefield, Mass.

Furnished in plates for machining. Abrasion resistance, medium; resists weak acids and alkalies; max cont. serv. temp, 200-250 F; slow burning; rigid; dielectric str, 200-500 volts per mil; ts, 35,000 psi; comp str, 20,000 psi; flexural str, 30,000 psi; moisture absorption, low; available in amber color; opaque; sp gr, 1.30-1.35; machinability, good. For use where lightweight and strength are required, such as textile picker sticks, etc. Also for forming dies for aluminum and light-gage steel, spinning chucks and assembly fixtures.

HIGH DENSITY ALLOY 112 (High tungsten alloy)—Callite Tungsten Corp., Union City, N. J.

Contains 85-90% tungsten. Furnished in rough bars or billets, finished rods or bars. Ts, 60-80,000 psi; ys, 70-75,000 psi; elong in 2 in., 1-2%; hardness, Rockwell A, 60-64. Can be silver soldered and brazed using regular technique. Is readily machinable; can be shaped, drilled, tapped in much the same fashion as a good grade of cast iron. At elevated temperatures red heat or thereabouts, it oxidizes slowly. At ordinary room temperature it resists atmospheric corrosion almost completely. Is particularly suited for balancing weights where space is at premium; for example, balancing weight for crankshafts for aircraft engines; balancing weight for controlling pitch in air screws, for centrifugal clutch plates, for rotors in gyroscopic devices. Because of its high density, it may also be used as a container for radio-active substances and as an absorption screen for radio-active radiations and x-rays.

HILLS McCANNA (Magnesium and aluminum-base alloys)—Hills-McCanna Co., Chicago.

Magnesium and aluminum base alloy sand castings.

HIPERCO (Iron-cobalt alloy) — Westinghouse Electric Corp., East Pittsburgh, Pa.

Contains approximately 1/3 cobalt, 2/3 iron and 1 to 2% of another element to increase electrical resistivity. Has higher magnetic saturation value and higher permeability at large magnetization forces than pure iron. Furnished in straight strip, sheet and plate for machining and hot or cold forging. In untreated state: Ts, 50,000 psi; ys, 40,000 psi; elong in 2 in., 2-4%; sp gr, 8.10. For magnetic parts where high magnetic saturation value and high permeability at high flux densities are desired.

HIPERNIK (Iron-nickel magnetic alloy)—Westinghouse Electric Corp., East Pittsburgh, Pa.

A magnetic alloy consisting of 49.5% nickel and 49.5% iron, manganese 0.1; extremely ductile. Developed for its high magnetic permeability at low and moderate inductions; primarily for radio and communication applications. Used for transformer laminations, relays, radio and current transformers, etc.

HIPERSIL (Magnetic silicon iron) — Westinghouse Electric Corp., East Pittsburgh, Pa.

A high permeability silicon iron whose optimum magnetic qualifications exist in the rolling direction. Makes possible lightweight core construction. Available in finished core form only. For a variety of applications in communications field, including radio and radar transformers, chokes, relays, reactors, etc. Available in three grades.

HI-STEEL (Corrosion resistant alloy) — Inland Steel Co., Chicago 3.

A low-alloy, high-strength steel furnished in plate, sheet, strip, structurals and bars; ts, 70,000 psi; ys, 50,000 psi; elong in 2 in., 22%; endurance limit, 49,000 psi. Suitable for hot or cold working, stamping, drawing, brazing, and welding. Can be precipitation hardened for higher mechanical properties. For reducing deadweight and increasing payload of equipment such as railroad freight and passenger cars, trucks, busses, mine cars, street cars, earth moving machinery, concrete mixers, etc. Has a high abrasion resistance and a high resistance to atmospheric corrosion.

HI-TEN-SI-LOY (Nickel-yellow brass) — Titan Metal Mfg. Co., Bellefonte, Pa.

Cu 57, Pb 1, Ni 1.75, balance Zn. Ts, 80-95,000 psi; ys, 40-50,000 psi; elong in 2 in., 20-30%; hardness, 70-90 Rockwell B; modulus of elasticity, 25,000,000 psi. Has high strength and good corrosion resistance combined with good machinability. Used for pump rods, valve stems, bolts, nuts, etc.

HITEST (Cast iron)—The Medart Co., St. Louis.

For ordinary cast-iron uses and for cast steel in some applications. Material is corrosion-resistant; has high tensile strength and good machinability.

HOMALITE (Thermosetting plastics) — The Homalite Corp., Wilmington 166, Del.

Type 100; furnished in sheets, rods or tubes, for casting, stamping and machining. Abrasion resistance, high; resistant to dilute acids, alkalies and all organic solvents; max cont serv temp, 300 F; dielectric str, 500 volts per mil; flexibility, low; ts, 5000 psi; flex str, 5,000 psi; moisture absorption, low; available in all colors; sp gr, 1.21; transparent, translucent, opaque.

Type 200; furnished in sheets for casting. Abrasion resistance, high; chemical resistance, excellent; max cont serv temp, 250 F; dielectric str, 500 volts per mil; ts, 2000 psi; flex str, 3000 psi; available in all colors; shatterproof; sp gr, 1.0; transparent, translucent, opaque.

HOTFORM (Hot-work die steel)—Vanadium Alloys Steel Co., Anchor Drawn Steel Co., Colonial Steel Div., Latrobe, Pa.

Hot-work die steel of 5% Cr type, available in three types; all furnished in rough bars or billets, finished rods or bars, sheet, plate, forgings and drill rod; for precision casting, machining, hot and cold working, stamping, drawing and brazing. In heat-treated state: Hardness, rockwell C, 55-59 max; magnetic; weldability, fair; max cont serv temp, 800-1000 F; good bearing qualities.

HOYT (Babbitt metal)—National Lead Co., New York 6.

Analysis of material varies according to the bearing application.

HUNT-SPILLER Gun Iron (Cast iron)—Hunt-Spiller Mfg. Corp., Boston 27.

Air furnace cast iron with analysis in accordance to customer's specification; furnished as sand castings. In untreated state: Ts, 35,000-60,000 psi. Outstanding characteristics: Uniformity, soundness, pressure tight, heat, abrasion and wear resistance. For pressure cams, gears and rings.

HUSSEY (Copper)—C. G. Hussey & Co., Div. of Copper Range Co., Pittsburgh.

Copper sheet, strip, drawn tubing and shapes, wire and rod to specification. Good machinability, weldability and formability. High general corrosion resistance. Excellent for electrical switch parts, bellows, eyelets, deep-drawn parts, trim for appliances, etc. Provides exceptionally good base for plating.

HYCAR (American rubber) — B. F. Goodrich Chemical Co., Cleveland 15.

Vulcanizable types of American-made rubber of butadiene base furnished in crude sheet and latex forms. Sheets may be compounded into any type of stock desired for further processing by molding, extruding and calendering. The latices may be compounded for coating, dipping and impregnating paper, cloth, leather and other allied materials.

Type OR-15 (oil-resistant); vulcanizable American rubber, butadiene-acrylonitrile copolymer; excellent oil, heat, abrasion and aging resistance; good flex life; ts, 2500-4500 psi; dielectric strength, 500 volts per mil; moisture absorption, medium; may be compounded in colors, or for blending with vinyl and phenolic resins. Hycar OR-15 EP (easy processing) represents a most recent development. Available in limited production quantities. Used for all resilient parts.

Type OR-25 (oil-resistant); vulcanizable American rubber, butadiene-acrylonitrile copolymer; abrasion resistance, high; resists corrosion caused by petroleum products; heat-resistant to 300 F; flexibility, high; dielectric strength, 500 volts per mil; ts, 2000-3500 psi; moisture absorption, low. This grade is available in an easy processing type, Hycar OR-25 EP, and easy processing, nonstaining type, Hycar OR-25 NS. NS is sold at a premium due to addition of selected ingredients. May be compounded in colors.

Type OS-10 (oil-soluble); vulcanizable American rubber, butadiene-styrene copolymer; furnished in sheets; for molding, extruding and calendering; flexibility, high; ts, 2000-3000 psi; moisture absorption, low; takes color. For abrasive wheels, electrical insulation, and general replacement for natural rubber.

All types used for gaskets, tubing, vibration insulators, packings, hose, printing rollers and blankets, wire covering and jacketing, and any other general type of application where resilient materials are required. All can be compounded to bonehard (Ebonars) with a 100 F higher softening point than obtainable with natural hard rubber.

HYDROCAL (Gypsum cements)—United States Gypsum Co., Chicago 6.

Pattern Shop Hydrocal: Has moderately low setting expansion; dimensional accuracy; is plastic, free forming and particularly suited for pattern and model making. A general-purpose gypsum cement which can be carved or otherwise worked freely.

A-11: A high strength gypsum cement with an exceptionally low setting expansion. Has a short period of plasticity and stiffens rapidly. This makes it difficult to form under a template.

B-11: Has a low setting expansion, high degree of plasticity, gradual setting action, and is specifically designed for use in the production of built-up models or template-formed models. It is harder to carve than Pattern Shop Hydrocal.

HYDROSTONE (Gypsum cement)—United States Gypsum Co., Chicago 6.

Extremely hard and strong; cannot be worked under a template; used where extreme surface hardness is required; expansion is greater than Grade A-11 or B-11 HYDROCAL.

HYFLEX (Rubber-like plastics tubing)—Irvington Varnish & Insulator Co., Irvington, N. J.

Has excellent abrasion resistance; does not become brittle at temperatures as low as —58 F; obtainable in six opaque colors; dielectric str, 1000 volts per mil (dry), 800 volts per mil (wet), for tubing of wall thicknesses approximately 0.020 in.; ts, 3000 psi; good chemical stability. For moderately low-temperature applications, wire insulation, conduit, lug insulation, low-pressure hose.

HYLASTIC (Cast steels) — American Steel Foundries, Industrial Div., Chicago 11.

Wide variety of carbon, low alloy, corrosion and heat resistant steels furnished in sand castings to specification.

HYTEMCO (High alloy nickel iron)—Driver-Harris Co., Harrison, N. J.

Alloy of nickel and iron characterized chiefly by its high-temperature coefficient of electrical resistance. Lends itself advantageously to uses requiring self regulation by temperature such as immersion heaters.

HY-TEMP (Composition) — Keasbey & Mattison Co., Ambler, Pa.

A combination of diatomaceous silica and asbestos fiber made into heat-insulating blocks, cements and pipe covering; high heat resistance; incombustible; and low thermal conductivity. Used for thermal insulation up to 1900 F.

HY-TEN (Alloy steel) — Wheelock, Lovejoy & Co, Inc., Cambridge 39, Mass.

A-1X: C 0.20, high Mn-Mo alloy steel, furnished in rough bars or billets, finished rods or bars and forgings; for machining and hot working, heat treated state; ts, 110,000 psi; ys, 65,000 psi; elong in 2 in., 25%; impact str, 85 ft-lb (Izod); weldability, fair; abrasion resistance, high. For gears, bushings, cams, clutches, bolts, etc.

B-2: C 0.40, Mn-Cr alloy steel; furnished in rough bars or billets, finished rods or bars and forgings; for machining and hot working. Untreated state: Ts, 100,000 psi; ys, 60,000 psi; elong in 2 in., 26%; bhn, 187; weldability, fair. For shafts, gears, spindles, screws, studs, racks, etc.

B-3X: C 0.50, Mn-Cr-Mo alloy steel; furnished in rough bars or billets, finished rods or bars, and forgings; for machining and hot forging. In heat-treated state: Ts, 181,000 psi; ys, 164,000 psi; elong in 2 in., 14%; impact str, 30 ft-lb (Izod); bhn, 388; weldability, fair; max cont serv temp, 900 F. For gears, axles, spindles, clutches, etc.

B Temper No. 5: C 0.95, electric furnace steel; furnished in rough bars or billets, finished rods or bars and forgings; for machining and hot working. In heat-treated state: Hardness, Rockwell C, 65; abrasion resistance, high; machinability, good. For cold heading dies, rolls, bushings, gages, cams, etc.

M Temper: C 0.70, Cr-Ni-Mo alloy steel; furnished in rough bars or billets, finished rods or bars and forgings; for machining and hot working. In heat-treated state: Ts, 294,000 psi; ys, 270,000 psi; elong in 2 in., 5½%; impact str, 5 ft-lb (Izod); hardness, Rockwell C 60. For rolls, cams, clutches, collets, gears, gages, etc.

HYTENAT (Aluminum castings)—B & S Bronze Foundry, Inc., Long Island City 1, N. Y.

High tensile strength aluminum castings requiring no heat treatment. Ts, 35,000 psi; ys, 25,000 psi; elong in 2 in., 4-5%; bhn, 74.

HY-TEN-SIL (Aluminum manganese bronzes)—American Manganese Bronze Co., Philadelphia 36, Pa.

Available in five grades as rough bars or billets, finished rods or bars, castings and forgings, as follows:

No. 1; Cu 60-68, Zn 20-24, Al 3-7, Mn 2.5-5 and Fe 2-4. In untreated state: Ts, 10,800 psi min; comp ys, 58,000 psi min; ys, 65,000 psi; elong in 2 in., 14 per cent; impact resistance, medium; bhn, 220; practically nonmagnetic; weldability, fair; heat resistant to 500 F; abrasion resistance, medium; pressure resistance, good. Used for lifting nuts, housing nuts, worm wheels (slow speed), spur and bevel gears, etc.

No. 1A; Cu 60-68, Zn 20-24, Al 3-7, Mn 2.5-5 and Fe 2-4. In untreated state: Ts, 11,500 psi min; comp ys, 65,000 psi min; ys, 75,000 min; elong in 2 in., 12 per cent; impact resistance, medium; bhn, 240 min; practically nonmagnetic; weldability, fair; resists corrosion caused by water, air, etc.; heat resistant to 500 F; abrasion resistance, medium. For same applications as No. 1.

No. 2 (sand cast); Ts, 100,000 psi; ys, 55,000 psi; elong in 2 in., 15 per cent; comp ys, 50,000 psi.

No. 3; Cu 60-68, Zn 20-24, Al 3-7, Mn 2.5-5 and Fe 2-4. In untreated state: Ts, 90,000 psi min; comp ys, 40,000 psi min; ys, 45,000 psi min; elong in 2 in., 20 per cent min; impact resistance, medium; bhn, 175; practically nonmagnetic; weldability, fair; resists corrosion caused by air, water, etc; heat resistant to 500 F; abrasion resistance, medium; good pressure resistance. For applications same as Nos. 1 and 1A.

No. 4 (sand cast); Ts, 85,000 psi; ys, 40,000 psi; elong in 2 in., 25 per cent; comp ys, 35,000 psi.

Also producers of manganese-bronze sand and centrifugal castings, hot-rolled and extruded rods, bars, shapes and sheets and forgings; gun metal sand and centrifugal castings; phosphor bronze sand castings; red brass sand and centrifugal castings; valve bronze sand castings; nickel-bronze and cupro-nickel castings; silicon bronze sand, centrifugal and permanent-mold castings, forgings, rods, bars, sheets, tubing and extruded sections; and bearing bronzes.

I

IDEAL ELECTRIC STEEL (Carbon and alloy steels)—The National Supply Co., Torrance, Calif.

Sand castings and open die forgings of various carbon and alloy steels produced to standard specifications such as SAE, AISI, and ASTM, etc.

IDEALOY (Bearing alloy)—Wellman Bronze & Aluminum Co., Cleveland.

Copper-tin-zinc alloy for heavy- duty bearings.

ILLINOIS (Sheet and strip zinc)—Illinois Zinc Co., Chicago 32.

Furnished in straight and coiled strip and in sheet and plate, for stamping and drawing. In untreated state; ts, 25,000 psi; weldability, poor; ductility, high. For nameplate and instruction plates, transformer cases, etc.

ILLIUM G (Cast nickel alloy)—Burgess-Parr Co., Freeport, Ill.

Ni 54-58, Cr 20-24, Cu 5-7, Mo 5-7, Mn 0.75-1.5, Si 0.65 max, C 0.2 max. Available in sand castings, permanent-mold castings, and precision castings to specifications. Other methods of fabrication include machining and arc, gas and resistance welding. No heat treatment required. Ts, 60-73,000 psi; elong in 2 in, 4 to 9.5%; Charpy impact, 40.3-52.1 ft-lb at room temperature; Bhn, 160-210; sp gr, 8.31; nonmagnetic; weldability, good, max cont serv temp, 1900 F; abrasion resistance, medium to good. Resists most corrosive solutions in a wide range of temperatures and concentrations including the halogens in dry state and their salts and acids in low concentrations at ordinary temperatures. For pumps, meters, chemical equipment and other parts subject to corrosion.

INCELOID (Thermoplastic plastics) — American Products Mfg. Co., New Orleans.

Cellulose derivative, furnished in sheets for extruding. Abrasion resistance, medium; resistant to mild acids and alkalies, water, hydrocarbons; max cont serv temp, 180 F; dielectric str, about 800 volts per mil; ts, 9000 psi; comp str, 11,000 psi; produced in color; moisture absorption, medium; sp gr, 1.27; translucent and transparent; machinability, good. For use as heat and electrical insulating covering.

INCONEL (High-Ni-Cr-Fe alloy)—International Nickel Co. Inc., New York.

Furnished in wrought and cast forms; nonmagnetic. Wrought form: Rod and bar, cold-drawn wire, hot-rolled plate, cold-rolled sheet and strip, cold-drawn tubing. Properties of wrought forms (ranges for various forms and tempers); Ts, 80-185,000 psi; ys, 25-175,000 psi; elong in 2-in., 50-2 per cent; bhn, 120-290. Good corrosion resistance; good hot and cold workability. Good high-temperature properties. For airplane-engine exhaust manifolds, springs that must operate at high temperatures, and in the food and chemical industries it is used for heaters, stills, condensers, tanks, piping, valves, etc. In photographic field it is used for pumps, reels, shafts, etc.

Inconel Castings: Untreated. Ts, 70-95,000 psi; ys 30-45,000 psi; elong in 2 in., 30-10 per cent; bhn, 160-190; nonmagnetic; weldability, good; abrasion resistance, medium; good high-temperature properties; good corrosion resistance. For parts which need high corrosion resistance and/or resistance to elevated temperatures.

INDIUM (Lead-silver solder)—Indium Corp. of America, New York.

A very soft metal used electrolytically or as a constituent of nonferrous alloys; commercial grade 99.9+ per cent pure; furnished in finished rods, bars, foil or powder; sp gr, 7.31; resists corrosion caused by salt spray and acids in oil; abrasion resistance, high. Used for bearing surfaces, protective coating for moving parts subject to wear and corrosion, etc.

INDUR (Phenolic-base plastics)—Reilly Tar & Chemical Corp., Indianapolis.

Thermosetting; furnished in powder form, for molding into parts; ts, 8560 psi; high dielectric strength; noninflammable;, low moisture absorption; high heat resistance; corrosion and abrasion-resistant; available in colors; flexibility, medium; sp gr, 1.37+. Used for instruments and machine accessories including insulating panels, knobs and handles, control levers, gears, etc.

INDUR VARNISH—Reilly Tar & Chemical Corp., Indianapolis.

Phenolic base, thermosetting; for molding into parts; high dielectric and tensile strengths; noninflammable; transparent; corrosion and heat-resistant; impact-resistant; and low moisture absorption. Used for laminated gears.

INDUSTREAL (Stainless steels) — Industrial Steels, Inc., Cambridge 41, Mass.

For data on types, properties, characteristics and applications see "Stainless Steels" listing at end of this section.

INGACLAD (Stainless-clad steel)—Ingersoll Steel & Disc Div., Borg-Warner Corp. Chicago.

Consists of a layer of 18-8 chrome-nickel, Type 304, also 18-8 columbium stabilized and 18-8 molybdenum bearing, stainless layer bonded to a layer of ordinary steel. Uses include equipment for chemical, food, dairy, processing, brewery, packing house, bottling industries, etc.; suitable for applications requiring stainless steel protection on one surface.

INGERSOLL (Stainless steels)—Ingersoll Steel & Disc Div., Borg-Warner Corp., Chicago.

Sheet and plate; for data on types, properties, characteristics and applications see "Stainless Steels" listing at end of this section.

INLAND (Steels)—Inland Steel Co., Chicago 3.

All AISI and SAE carbon steels; also carbon steels to ASTM and ARA mechanical property specifications, and chrome-manganese and silico-manganese alloy spring steels. Also can furnish any carbon steel to special chemical or mechanical requirements conforming to the limits set up as acceptable by the AISI.

INSULKOTE (Weatherproof coating) — Johns-Manville, New York 16.

Weatherproof, heat-resistant coating for use over insulation of ducts and other exposed equipment.

INSUROK (Plastics)—The Richardson Co., Melrose Park, Ill.

Thermosetting type: Furnished in laminated sheets, rods and tubes for machining or punching into parts, or as finished fabricated or molded parts; corrosion-resistant; low moisture absorption; high tensile strength; resistant to shock; comparatively low specific gravity. Used for gears, bearings, electrical insulation. Available in different grades.

Thermoplastic type: Furnished in molded parts; high dielectric strength; low moisture absorption; high tensile strength; low specific gravity. Available in color.

Translucent type: Urea, melamine or phenolic base, thermosetting in laminated sheets and fabricated parts, for instrument dials, etc. Material is translucent.

INTERLAKE (Plastic resins and molding compounds)—Interlake Chemical Corp., Cleveland 14.

Phenol formaldehyde thermosetting liquid resins for bonding, impregnating, laminating and surfacing. Applications include bonding of mineral wool and fiberglas for insulation, glues for plywood, impregnating wood, paper and cloth for plastics laminates.

Phenol formaldehyde thermosetting molding compounds supplied in powder form with various fillers such as wood flour, fabric or mineral, to be molded under heat and pressure.

INTERNATIONAL (Graphite) — International Graphite & Electrode Corp., St. Marys, Pa.

Graphite electrodes for electric furnaces, graphite anodes for electrolytic cells, graphite molds for casting alloys, pressure sintering and centrifugal casting.

INTRA (Tool steel) — H. Boker & Co., Inc., N. Y. C.

Water-hardening tungsten alloy steel. For taps, woodworking tools, mandrels, etc.

INTUC (Plastics laminate)—Insulating Tube Co. Inc., Poughkeepsie, N. Y.

Thermosetting phenol formaldehyde laminate furnished in sheet and tube form; ts, 8265 psi; dielectric str, 720 volts per mil. inst. short time; available in natural tan and black; moisture absorption, low; machinability, good.

INVAR (Low expansion alloys)—Carpenter Steel Co., Reading, Pa.

Low expansion iron-nickel alloys, furnished in finished rods, bars, and strip. Various types available to meet expansion rates between different temperature ranges. Free-machining grade for automatic screw machine parts. Analyses for two types are:

Type 36; C 0.12 max, Mn 0.35, Si 0.20 max, and Ni + Co 36.

Type 36 Free-cut; C 0.12 max, Mn 0.35, Si 0.20 max, Ni + Co 36, and Se 0.20.

IRALITE (Alloy cast iron)—Mackintosh-Hemphill Co., Pittsburgh.

C 2.8-3.5, plain and alloyed cast iron; Ni, Mo and Cr as required. Furnished as castings. Ts, 40-75,000 psi; bhn, 175-400; magnetic; resists corrosion caused by acids; heat-resistant to 1500 F; abrasion resistance, high. For lathe and engine beds, etc.

IRILITE (Sheet plastic)—The Richelieu Corp., New York.

Methyl methacrylate or vinyl chloride acetate thermoplastic plastic furnished in sheet. Produced in many colors; moisture absorption, low; is opaque; machinability, good. These sheets are impregnated with iridescent particles for use in toilet-ware displays, optical frames, musical instruments, etc.

IRVINGTON (Insulating varnishes) — Irvington Varnish & Insulator Co., Irvington, N. J.

Synthetic, internal-drying, clear and black insulating, oleo-resinous type varnishes; air-drying varnishes; clear or black oilproof finishing varnishes, sticking varnishes, red, oilproof enamels; gray or black machinery enamels. Wide selection to meet ordinary and special requirements.

IRVINGTON (Varnished fabrics) — Irvington Varnish & Insulator Co., Irvington, N. J.

Varnished cambric, canvas, cotton, duck, Fiberglas, silk, Nylon, rayon. Silicone varnished Fiberglas, varnished papers; ranging from thin condenser tissues to heavy fibrous types.

Plastic marker insulators; extruded plastic tubing sleeves, marked to specifications; serve both as wire markers and lug insulators; high dielectric strength; resistant to heat, acids, alkalies, oil and many solvents; do not support combustion. Obtainable in numerous color combinations, and in standard tubing sizes.

Transformer lead tubing; made to specifications, consisting of several layers of varnished cambric over which saturated braid has been drawn; assembly is dipped in varnish and thoroughly baked.

Varnished markers; short lengths of varnished tubing marked to specifications. Used to identify leads; inside-and-out coatings resist oil, gasoline, washing down of motors, high engine temperature.

IRV-O-LITE XTE 30 (Thermoplastic plastics)—Irvington Varnish & Insulator Co., Irvington, N. J.

Thermoplastic, furnished in rods, tubes and for extruding. Abrasion resistance, high; chemical resistance, good; max cont serv temp, 170 F; flexibility, high; dielectric str, 1000 volts per mil; moisture absorption, low; produced in black, green, white, yellow, red and blue; sp gr, 1.293; opaque. For wire insulation, conduit, lug insulation, etc.

IRV-O-SLOT (Insulation)—Irvington Varnish & Insulator Co., Irvington, N. J.

Stator or armature slot insulation. Consist of vanished fabrics duplexed to fish or 100 per cent rag papers; flexible binding adhesive prevents separation during shaping and forming, contributes to insulating qualities. Obtainable in a wide variety of combinations and thicknesses in the form of sheets, tape and punchings.

IRV-O-VOLT (Flexible varnish tubing and sleeving)—Irvington Varnish & Insulator Co., Irvington, N. J.

Flexible varnished inside-and-outside tubing; obtainable in six colors. Braided cotton, rayon, Fiberglas tubular sleeving, treated with oleo-resinous varnishes.

Types A-1, B-1, C-1 and C-2; conform to ASTM and VTA specifications for similarly designated grades; inside varnish coating yields a smoother inside wall, speeding assemblies; greatly retards moisture absorption; eliminates feathering action of ordinary braid and wicking action when used in oil-filled transformers; provides margin of insulation protection should outside coating become chafed.

ISOCAST (Aluminum castings)—Permaloy Corp., Reading, Pa.

Various standard aluminum alloys furnished in the form of permanent-mold castings to specification.

ISOCAST (Steel castings)—Empire Steel Castings Inc., Reading, Pa.

A wide variety of low alloy and corrosion and heat-resistant stainless steels, supplied in sand castings to specifications.

ISOLANTITE (Ceramic)—Isolantite Mfg. Corp., Stirling, N. J.

Furnished in strips, rods and tubes and plates; fabricated into parts by molding, casting, extruding, pressing and machining. Abrasion resistance, high; chemical resistance, high to all chemicals except HF; max cont serv temp, 1800 F; noninflammable; flexibility, low; dielectric str, 250 volts, per mil inst; ts, 8000 psi; compr str, 120,000 psi; flexural str, 20,000 psi; elong, nil; moisture absorption, low; produced in white, brown and various other colors; sp gr, 2.6; is opaque; machinability, poor; primarily used for its insulation and corrosive properties.

IVI-FLEX (Flexible plastics tubing)—Irvington Varnish & Insulator Co., Irvington, N. J.

Extruded plastics tubing, developed for use at extremely low temperatures; ts, 1000 psi; elongation at break, 400%.

J

JALCASE (Steels)—Jones & Laughlin Steel Corp., Pittsburgh 30.

Low-carbon open-hearth steel which offers machinability practically equivalent to bessemer screw stock plus the added advantage of rapid case-carburizing properties; manufactured as AISI C-1117 and C-1118 (SAE 1117 and 1118), carbon 0.14-0.20.

Open-hearth steel which in the higher carbon range offers exceptional heat treating qualities combined with forging properties and good machinability; manufactured as AISI C-1132 (SAE 1132), carbon 0.27-0.34; AISI C-1137 (SAE 1137), carbon 0.32-0.39; AISI C-1141 (SAE 1141), carbon 0.37-0.45.

JALLOY (Special steel)—Jones & Laughlin Steel Corp., Pittsburgh 30.

Special steel for use where heavy impact and dynamic stresses are required. For parts such as pins and links on earth-moving, agricultural, mining and oil-well equipment.

JAMESTOWN (Plywood)—Jamestown Veneer & Plywood Corp., Jamestown, N. Y.

Hot-pressed, resin-bonded plywood; thermosetting; furnished in sheets for machining. Abrasion resistance, low; resists corrosion caused by moisture; heat resistant to 400 F; flexibility, low and medium; approx ts, 2000 psi; comp str, 250 psi; produced in natural wood; largely shatterproof; sp gr, 0.45-0.60; machinability, good.

JEFALOY (Cast iron)—The Jeffrey Mfg. Co., Columbus 16, O.

55M; total C 2.85-3.05, Mn 0.50-0.70, Si varying, Mo 0.70-0.80; furnished as castings; ts, 50-60,000 psi; comp str, 171-174,000 psi; bhn, 248-269. For wear-resistant, high-strength parts.

A Series; C 2.85-3.50, Mn 0.30-0.75, Si varying; furnished as castings; ts 35-50,000 psi; comp str, 126-170,000 psi; bhn 192-248. For pump parts, gears, sprockets, frames, housings, etc.

JESSOP (Stainless steels) — Jessop Steel Co., Washington, Pa.

For data on types, properties, characteristics and applications see "Stainless Steels" listing at end of this section.

JEWELL Alloys (Ductile white irons) — Kencroft Malleable Co. Inc., Buffalo 7.

Silicon, approx 1.00, total carbon 1.90, chrome 0.35, and nickel 0.1; furnished as sand castings. Thoroughly heat-treated before shipment and requires no further heat treatment for physicals shown. Ts, 90,000 psi; ys, 60,000 psi; elong in 2 in., 8%; weldability, fair; resists corrosion caused by heat, mild acids and alkalies; max cont serv temp, 1200-1300 F; abrasion resistance, high; polishes like nickel plate by ordinary buffing. For industrial uses.

No. 42; silicon, approx 1.00, total carbon 1.90, chrome 0.20, and nickel 0.50; furnished as sand castings. Thoroughly heat treated before shipment and requires no further heat treatment for physicals shown. Ts, 70,000 psi; ys, 50,000 psi; elong in 2 in., 5%; weldability, fair; resists corrosion caused by heat, mild acids and alkalies; max cont serv temp, 1100 F. Recommended as a free-machining material with high yield point and enough ductility to stand shock and abuse. For all industrial uses.

"V"; silicon approx 1.00, total carbon 1.90, chrome 0.35, and nickel 0.50; furnished as sand castings. Thoroughly heat treated before shipment and requires no further treatment for physicals shown. Ts, 85,000 psi; ys, 70,000 psi; elong in 2 in., 5%; weldability, fair; resists corrosion caused by heat, mild acids and alkalies; max cont serv temp, 1000-1100 F; abrasion resistance, high; especially recommended for compressor valves and wherever battering of two metals is encountered. For all industrial uses.

J & L Steels (Cold-finished steel) — Jones & Laughlin Steel Corp., Pittsburgh 30.

Cold finished steel in bars, shapes, rounds, flats, hexagons and special shapes; easily machined. For gears, tubing, piston pins generator parts and shafts, steering wheel hubs, etc. Also special cold-drawn shapes and Electricweld mechanical tubing.

JODA (Thermoplastic plastics) — Joseph Davis Plastics Co., Arlington, N. J.

Furnished in sheet, strip, rods or tubes, plates and film. Abrasion resistance, medium; max cont serv temp, 130 F; furnished transparent and in all colors; is shatterproof; sp gr, 0.9-1.3; machinability, good. Used for dials, lenses, knobs, wheels, etc.

JODAPAC (Thermoplastic plastics)—Joseph Davis Plastics Co., Arlington, N. J.

Polythene or polyethylene thermoplastic plastics furnished in sheet, rods, tubes, and film. Max cont serv temp, 100 F; dielectric str, (volts per mil inst), 400-600; ts, 17-1900 psi; produced in all colors; moisture absorption, low; sp gr, 0.92; produced transparent, translucent, and opaque; machinability, fair. Used in electroplating industry, food packaging, etc.

JOHNSON (Rubber)—Johnson Rubber Co., Middlefield, O.

Molded and extruded rubber in any shape and quantity to specification.

JOHNSON (Bearing metals)—Johnson Bronze Co., New Castle, Pa.

Babbitts furnished in following grades:

No. 10 (SAE 10); Sn 90, Cu 5, Sb 5; furnished in rough bars or billets, for permanent-mold casting and die casting. Ts, 10-13,000 psi; comp str, 5-7000 psi; bhn, 28-30; sp gr, 7.2; nonmagnetic; resists corrosion caused by organic acids in lubricating oils; max cont serv temp, 200-250 F; abrasion resistance, high. For automotive main and connecting-rod bearings; high-speed, medium-load and precision-assembly bearings, etc.

No. 11 (SAE 11); Sn 87, Sb 7, Cu 6; furnished in rough bars or billets for permanent-mold and die casting. Ts, 10-13,000 psi; comp str, 5-6000 psi; bhn, 28-29; sp gr, 7.2; nonmagnetic; resists corrosion caused by organic acids in lubricating oils; max cont serv temp, 200-250 F. For automotive main and connecting-rod bearings subjected to heavy pressures.

No. LX (SAE 14); Pb 74-75, Sb 15, Sn 10, Cu 0.25; furnished in rough bars or billets, for permanent-mold or die casting. Annealed before machining. In untreated state: Ts, 8-12,000 psi; comp str, 5-6000 psi; bhn, 27-29; sp gr, 10.0; nonmagnetic; resists corrosion caused by organic acids in lubricating oils; max cont serv temp, 200-225 F; abrasion resistance, high. For car box journals, crane bearings, woodworking and metalworking machine tools, mining machinery bearings, automotive applications, etc.

Bronze alloys in following grades:

No. 19; Cu 70, Sn 11, Pb 19; cast to specifications, for machining. In untreated state: Ts, 22,500-32,500 psi; comp str, 13,000-15,000 psi; ys, 18,000-24,000 psi; elong in 2 in., 14 to 17%; impact str, 3.4 ft-lb (Izod); bhn, 62; sp gr, 8.98; nonmagnetic; resists corrosion caused by atmospheric conditions and fresh water; max cont serv temp 300-400 F; abrasion resistance, high. Used on mill bearings, gas and diesel engine bearings, excavating and pulverizing machinery, etc.

No. 25 (Plastic Bronze); Cu 75, Sn 5, Sb 19, Ni 1, cast to specifications for machining. In untreated state: Ts, 17,500-27,500 psi; comp str, 8-12,000 psi; ys, 13,750-19,750; elong in 2 in., 7 to 15%; impact str, 5.2 ft-lb (Izod); bhn, 44; sp gr, 9.05; nonmagnetic; resists corrosion caused by diluted acids, atmospheric conditions, and fresh water; max cont serv temp, 300-400 F; abrasion resistance, high. For sleeve bearings used in pumps, electric motors, conveyors, fans, woodworking and lapping machines. For high speeds, light loads and no shock.

No. 27 (SAE 64); Cu 80, Sn 10, Sb 10, deoxidized with phosphorus; furnished in finished rods or bars and cast to specifications. In untreated state: Ts, 30-40,000 psi; comp str, 13-15,000 psi; ys, 16-22,000 psi; elong in 2 in., 10 to 30%; impact str, 4.5 ft-lb (Izod); bhn, 58; sp gr, 8.75; nonmagnetic; resists corrosion caused by most acids, highly diluted, sea air, atmosphere and fresh water; max cont serv temp, 300-400 F; abrasion resistance, high. For sleeve bearings for most machinery and machine tools, valve and pump parts, general automotive bearings, appliances, etc.

No. 29 (SAE 67); Cu 78, Sn 7, Sb 15; cast to specifications. In untreated state: Ts, 10-29,000 psi; comp str, 13-15,000 psi; ys, 13,400-19,400 psi; elong in 2 in., 5 to 13%; impact str, 5.6 ft-lb (Izod); bhn, 52; sp gr, 8.9; nonmagnetic; resists corrosion caused by 20 per cent solution hydrochloric acid, other diluted acids, atmospheric conditions, etc.; max cont serv temp, 300-400 F; abrasion resistance, high. For high-speed sleeve bearing applications with medium loads and soft shafts, acid-resisting bearing applications, fractional horsepower motors, etc.

No. 53 (SAE 62); Cu 88, Sn 10, Zn 2, cast to specifications. In untreated state: Ts, 31-41,000 psi; comp str, 13-16,000 psi; ys, 16-22,000 psi; elong in 2 in., 14 to 22%; impact str, 8.5 ft-lb (Izod); bhn, 69; sp gr, 8.5; nonmagnetic; weldability, fair; resists corrosion caused by atmospheric conditions, fresh water, highly diluted acids and sea water; max cont serv temp, 600-900 F; abrasion resistance, high. For gears and gear bushings, piston-pin and valve-guide bushings, steering-sector and hinge bushings, heavy-duty bearings, high-pressure air valves.

No. 72 (SAE 660); Cu 83, Sn 7, Sb 7, Zn 3; furnished in finished rods or bars, cast to specifications. In untreated state: Ts, 24-34,000 psi; comp str, 12-14,000 psi; ys, 11,600-17,600 psi; elong in 2 in., 12 to 22%; impact str, 8.6 ft-lb (Izod); bhn, 56; sp gr, 8.7; nonmagnetic; resists corrosion caused by atmospheric conditions, fresh water and highly diluted acids; max cont serv temp, 300-400 F; abrasion resistance, high. For general machinery bearing applications.

K

"K" (Felt)—American Felt Co., Glenville, Conn.

Kapok felts to Air Corps Specification 16098, Types I and II. Material is corrosion-resistant, impact-resistant and noninflammable; for insulating, etc.

K-42-B (Ni-Co-Cr-Fe alloy)—Westinghouse Electric Corp., East Pittsburgh, Pa.

Ni 46, Co 20, Fe 12, Cr 18.75, Ti 2.25; furnished in rough bars or billets, rods or bars, wire, strips (coiled), and plates; for hot forging, stamping, turning, boring, welding, etc., also as sand castings. Resists corrosion caused by atmosphere and salt solutions; resists heat to 1200 F; ts, 127,100 psi; nonmagnetic; bhn, heat-treated 280. For applications where high strength at high temperatures is required.

KAISER ALUMINUM (Aluminum alloys)—The Permanente Metals Corp., Oakland 12, Calif.

Aluminum alloys 2S, 3S, 52S, 61S, 24S, 75S. Furnished in flat and coiled sheet, plate and circles. Corrugated and 5 V Crimp roofing sheet. Residential siding.

KARBATE (Impervious carbon and graphite)—National Carbon Co., Inc., New York 17.

Corrosion-resistant materials. Impervious to seepage of liquids and gases under pressure. Possesses, among others, the following characteristics: Resistance to action of all acids, alkalies and salt solutions except those of a highly oxidizing nature, freedom from corrosion scale formation, resistance to thermal shock, and ease of machining. Impervious graphite base products have excellent thermal conductivity.

Available in the form of brick, plates, tile, pipe, fittings, valves, pumps, heat exchangers, towers and tower accessories such as bubble caps, trays, distributor plates, etc. Highly resistant to reaction with most materials encountered in chemical manufacturing plants and chemical processes at the concentrations and temperatures ordinarily employed.

KENNAMETAL (Tungsten-titanium carbides and tungsten carbides)—Kennametal, Inc., Latrobe, Pa.

Grade KM; tungsten-titanium carbide ($WTiC_2$) with other refractory metal carbides, and the optimum content of binder, furnished in powder metal, sintered form. Not heat-treatable; trans. str, 305,000 psi; comp str, 600,000 psi; ys, 305,000 psi; modulus of elasticity, 74,000,000 psi; impact str, 8.9 ft-lb (Charpy); endurance limit, 85,000 psi; hardness, rockwell C, 77.6; sp gr, 12.00; magnetic permeability, 3.00; resistance to corrosion, excellent at room temp; max cont. serv. temp, 1200 F; abrasion resistance, high. For pins and rollers, bushings, cam followers, bearings, chuck jaws, spindles, check-valve balls and seats, seaming rolls, etc., where galling is involved.

Grade K3H; contains higher percentage of tungsten-titanium carbide ($WTiC_2$), and lower content of cobalt, than grade KM, consequently it is not quite as strong, but considerably harder. Trans str, 260,000 psi; comp str, 585,000 psi; Young's modulus of elasticity, 72,100,000 psi; impact str, 5.3 ft-lb (Charpy); hardness, Rockwell C, 79.6; sp gr, 11.10; magnetic permeability, 2.00. It resists oxidation and corrosion at high temperature better than other standard grades. Useful for same applications as KM, but has greater resistance to galling.

Grade K6; primarily composed of tungsten carbide with low content of cobalt binder; furnished in powder metal, sintered forms. Not heat-treatable. Trans. str, 260,000 psi; comp str, 800,000 psi; ys, 225,000 psi; modulus of elasticity, 94,300,000 psi; impact str, 9.5 ft-lb (Charpy); endurance limit, 85,000 psi; hardness, rockwell C, 80.6; sp gr, 15.10; magnetic permeability, 1.5; resistance to corrosion, excellent at room temp; max cont. serv. temp, 1200 F; abrasion resistance, high. For valve tappets, work rests, dovetail ways, wear-proofing strips, guides, bushings, needle valves, feeding fingers, serrated inserts for clamping devices, band-saw guides, etc.

Grade K12; straight tungsten carbide containing high percentage of cobalt binder; furnished in powder metal sintered forms; not heat treatable. Trans str, 360,000 psi; comp str, 660,000 psi; Young's modulus of elasticity, 77,000,000 psi; ys, 350,000 psi; endurance limit about 100,000 psi; hardness, Rockwell C, 75.2; sp gr, 14.05; magnetic permeability, 3.7; resistance to corrosion excellent at room temperature; max cont serv temp, 1200 F; abrasion resistance, high. Applications similar to that of Grade K6, but where greater transverse strength is required. Most shock proof of all Kennametal grades.

Grade KE5; Special straight tungsten carbide-cobalt composition for extruded forms only. Hardness, 76.0 Rockwell C. Strength compares favorably with similar commercial grades. Produced in small rods or tubes of uniform cross section, suitable for use in gage elements, pins, pivots, feeding fingers, guides, and other small parts to which extruded forms can be adapted.

Grade KE7; Similar to KE5, but with greater hardness—79.0 Rockwell C.

KEY (Graphite paste)—Key Co., East St. Louis, Ill.

Semi-fluid joint sealing compound used for sealing threaded and gasket joints in oil lubrication systems, gear housing joints and similar connections. Insoluble in oil and other petroleum liquids.

KEYSTONE (Carbon and alloy steels)—Keystone Drawn Steel Co., Spring City, Pa.

Standard analyses cold-finished steel bars; carbon and alloy.

KGI (Glass)—Kopp Glass Inc., Swissvale, Pa.

Glass for marine, aviation, railroad and industrial applications. Types include technical glass, ultra-violet glass, heat-resisting glass, colored glass, crystal clear glass and opal glass.

KIDD (Steels)—Kidd Drawn Steel Co., West Aliquippa, Pa.

Flats, squares and special shapes in SAE grades, special alloys and open hearth and electric furnace tool steels. Analyses, characteristics and properties depend on grades of material, and according to customers' specifications.

KINITE (Tool steel)—H. Boker & Co., Inc., N. Y. C.

High-carbon, high-chrome air-hardening tool steel furnished in bars, castings, forgings. At Rockwell C 55, comp str is 300,000 psi; in cast form ts is 100,000 psi; in bar form, 200,000 psi. For dies, cams, slitting cutters, etc.

KLEENKUT (Chromium steel)—Heppenstall Co., Pittsburgh.

Tool steel containing C 2 and Cr 12. For sheet knives for cold shearing light material.

KOPPERS (Adhesive for polystyrene)—Koppers Co. Inc., Chemical Division, Pittsburgh 19.

An adhesive for joints in which one element is polystyrene; supplied in fluid form. Is resistant to water, alkalis, acids, and lower alcohols and oils, when set. Is transparent; gives clear, bubble and craze-free autogenous joints as strong as the polystyrene itself. For bonding polystyrene to paper, cardboard, fabric, glass, rubber, and certain other plastics.

KOPPERS CELLULOSE ACETATE (Thermoplastic molding material)—Koppers Co. Inc., Chemical Division, Pittsburgh 19.

Cellulose acetate thermoplastic molding material furnished in the form of granules and pellets for injection molding and extruding. Abrasion resistance, high; is resistant to water, low concentrations of alkalis and acids and petroleum solvent; max cont serv temp, 110-150 F; flexural str, 2000-14,000 psi (ASTM D 650); dielectric str, 250-450 volts per mil inst; ts, 3000-10,000 psi; comp str, 5000-30,000 psi; impact str (Izod), 0.4-6.0 ft-lb per inch notch; produced in all colors and clear; moisture absorption, low; sp gr, 1.27-1.37; produced transparent, translucent and opaque; machinability, excellent; hardness, Rockwell M20-M120; co-

efficient of thermal expansion, 10—15 x 10^{-5} inch/inch/degree C. Tough, resilient and resistant to impact; thus well-suited for strong, lightweight, thin-walled articles. For knobs, controls, dials, wheels, electrical insulation, shields, nameplates, washers, housings, etc.

KOPPERS ETHYL CELLULOSE (Thermoplastic molding material)—Koppers Co. Inc., Chemical Division, Pittsburgh 19.

An ethyl cellulose thermoplastic molding material furnished in the form of granules and pellets for injection molding and extruding. Abrasion resistance, medium; is resistant to alkalis, weak acids, water and salt solutions; max cont serv temp, 135 F; flexural str, 3000-12,000 psi (ASTM D 650); dielectric str, 400-600 volts per mil inst; ts, 2000-10,000 psi; comp str, 8000-20,000 psi; impact str (Izod), 0.6-11.5 ft-lb per inch notch; produced in all colors except clear; moisture absorption, low; sp gr, 1.07-1.18; produced transparent, translucent and opaque; machinability, good; hardness, Rockwell M25-M90; coefficient of thermal expansion, 10-14 x 10^{-5} inch/inch/degree C. Has excellent toughness and dimensional stability at low temperatures. For knobs, controls, trim, handles, nameplates, refrigerator breaker strips, etc.

KOPPERS POLYSTYRENE (Plastic molding material)—Koppers Co. Inc., Chemical Division, Pittsburgh 19.

A polystyrene thermoplastic molding material furnished in the form of granules, beads and pellets for injection molding and extruding. Abrasion resistance, medium; is resistant to water, alkalis, acids and lower alcohols and oils; flexural str, 8-12,000 psi (ASTM D 650); dielectric str, 450-650 volts per mil inst; ts, 5-9000 psi; comp str, 12-16,000 psi; impact str (Izod), 0.3-0.4 ft-lb per inch notch; produced in all colors and clear crystal; moisture absorption, low; sp gr, 1.045-1.07; produced transparent, translucent and opaque; machinability, good; hardness, Rockwell M70-M85; coefficient of thermal expansion, 6—8 x 10^{-5} inch/inch/degree C. A low-cost material having very desirable physical, electrical and chemical properties. Used for knobs, dials, control wheels, electrical insulation, shields, etc.

KOROSEAL (Synthetic elastic) — The B. F. Goodrich Co., Akron, O.

Flexible material; furnished in various consistencies from jelly to bone-like hardness; corrosion and shock-resistant; noninflammable; available in colors. Jelly is used for making molds for casting plastics; other compounds sold only as finished products. Superior to rubber in flexing, oxidation and penetration of moisture or gases; does not swell in oil. Available in molded and extruded forms and sheets; also applied as coating to paper and fabric.

KORRY-KROME (Leather)—J. W. and A. P. Howard Co., Corry, Pa.

Used for bumper blocks, polishing disks, leather packings and valve disks.

KOVAR (Iron-cobalt-nickel alloy)—Westinghouse Electric Corp., East Pittsburgh, Pa.

Iron alloy containing 29% nickel, 17% cobalt and 0.3% manganese. Ts, 89,700 psi; elong in 2 in., 25%; ys, 50,500 psi; high resistance to amalgamation with mercury and withstands high thermal shock. For any application demanding vacuum-tight, metal-to-glass joints.

KRISTON "A" (Allyl ester thermosetting plastics)—B. F. Goodrich Chemical Co., Cleveland.

Furnished in crystals for casting and "contact" laminating. Has medium abrasion resistance and excellent chemical resistance. Max cont serv temp, 226 F (heat distortion point—66 psi fiber stress); flexural str, 14,000 psi; dielectric str, 1275 volts per mil; ts, 19,600 psi; impact str, 0.2 ft lb (Izod); furnished in natural clear form but can be made any color by fabricator; moisture absorption, low; machinability, fair. For viewing ports, nameplates and control knobs, by casting; and gear covers and other semi-structural parts by laminating.

KWIKMETAL (Liquid Solder)—Atomized Materials Co. Inc., Pittsburgh 22.

A metallic plastic surface solder consisting of atomized aluminum in plastic bond. Furnished as putty in cans; used for filling pits, gouges, sand and air holes in castings, and for general smoothing foundations for painting over all fabricated metal designs. Also may be thinned with KWIKMETAL solvent for brush or spray application to metal as protective and decorative coating. Material resists corrosion caused by water, acids, oils, grease, gasoline, etc.

KYS-ITE (Thermosetting phenol - formaldehyde plastics)—Keyes Fibre Co., Waterville, Me.

K-100; furnished as finished moldings. Abrasion resistance, low; resistant to boiling water, mild alkali, mild acid, and most organic solvents; dielectric str, 300-400 volts per mil; ts, 12,000 psi; comp str, 19,000-35,000 psi; flex str, 18,000 psi; moisture absorption, low; available in medium and dark shades; sp gr, 1.39-1.45; opaque; machinability, good. A high impact strength material coupled with lustrous finish it can be used as handwheels, small structural parts and other machine parts.

K-300; furnished same as K-100. Abrasion resistance, medium; resistant to boiling water, mild alkali, mild acid and most organic solvents; flex str, 7000-10,000 psi; dielectric str, 300-400 volts per mil; ts, 4500 psi; comp str, 16-25,000 psi; moisture absorption, low; available in medium to dark shades; sp gr, 1.36 to 1.42; opaque; machinability, good. For intricate shapes, housings, machine covers, business machine frames, etc.

L

LAMICOID (Thermosetting plastics laminate)—Mica Insulator Co., Schenectady 1, N. Y.

Phenolic and urea base thermosetting laminated sheets, rods and tubes; for machining and stamping into parts; can be furnished highly polished or satin; abrasion resistance, high; heat resistant to 250 F; moisture absorption, low; furnished in natural and black, impact-resistant; and has high dielectric strength. Used for gears, electrical and mechanical insulation, instruction charts, dials, etc.

LAMINAC (Unsaturated polyester resin)—American Cyanamid Co., New York 20.

For laminating or casting; furnished in various grades, Ts, 41,500 psi; comp str, 14,900 psi; imp str (flatwise), 33 ft lb (Izod); heat resistance depends on filler.

LAMINEER (Laminated plastics) — General Plastics Corp., New York 19.

Laminated plastics furnished in sheets for molding. Abrasion resistance, high; chemical resistance, excellent to mild acids and alkalies, alcohol and other solvents. Max cont serv temp, 250 F; noninflammable; dielectric str, high; moisture absorption, low; available in all colors, translucent and opaque; shatterproof; sp gr, 1.35; machinability, good. For any application requiring a combination of excellent resistance to chemical attack and abrasion with attractive appearance.

LAMINUM (Laminated shim stock)—Laminated Shim Co. Inc., Glenbrook, Conn.

Laminated shim stock furnished in the form of sheet in commercial high brass and SAE 1010 steels.

LAMITEX (Laminated phenolic plastics) — Franklin Fibre-Lamitex Corp., Wilmington, Del.

Thermosetting; furnished in sheets, rods or tubes in laminated form for machining, punching and screw machine work. Abrasion resistance high; heat resistant to 300 F; dielectric str, 150-750 volts per mil; ts, 7500-12,500 psi; comp str, 32,900-38,000 psi; moisture absorption, low; produced in black and natural; sp gr, 1.36-1.38; opaque. For all parts for radio, radar, communication systems, airplanes, vessels, tanks, trucks, automobiles, etc.

LA-SULPHITE 8640 (Manganese steel) — La Salle Steel Co., Hammond, Ind.

C 0.38-0.43, Mn 0.75-1.00, P 0.04 max, S 0.04-0.06, Si 0.20-0.35, N 0.40-0.70, Cr 0.40-0.60, Mo 0.15-0.25. Furnished as finished bars for machining. Oil quench, 1525-1550 F, temper to desired hardness. For gears, splines, shafts, axles, etc.

LATERNEX (Arc welding electrode)—Metal & Thermit Corp., New York.

Produces deposit of 62-75,000 psi ts; 52-61,000 psi; elong in 2 in., 17-25 per cent. For guards, furnaces, tanks and other light-gage fabrication.

LAVITE (Steatite ceramic) — D. M. Steward Mfg. Co., Chattanooga 1, Tenn.

For molding, machine, and extruding. Abrasion resistance, high; noninflammable; flexibility, low; dielectric str, 235 volts per mil; ts, 7200 psi; comp str, 96,000 psi; flexural str, 10,500 psi; moisture absorption, low; available in white, opaque. Can be used as a substitute for metal, fiber or plastics parts for mechanical use, such as washers, bushings, etc. Material can be machined.

LAVOLAIN (Ceramic) — Star Porcelain Co., Trenton, N. J.

Available in special molded shapes to specification. Abrasion resistance, high; chemical resistance, high; max cont serv temp, to 1200 F; ts, 6000 psi; comp str, 60,000 psi; flex str, 15,000 psi; moisture absorption, low; produced in the colors white and brown; is not shatterproof; sp gr, 2.4; is opaque; machinability, poor. A dense material of high mechanical strength and excellent resistance to rapid heat changes. Used for heat units in electric ovens, roasters, toasters, irons, heaters, etc.

LECTRO-PAT (Aluminum alloys)—The Cleveland Electro Metals Co., Cleveland 13.

Aluminum alloys to specification in the form of pig or ingot, rough bars or billets, and permanent-mold castings.

LEDALOYL (Powder metal bearing alloys)—Johnson Bronze Co., New Castle, Pa.

Cu 83-85, Sn 9.5-10.5, Pb 2-4 and graphite 1.5 max; furnished in powder metal parts to specification. In untreated state: Ts, 7-12,000 psi; comp str, solid block, 57-70,000 psi; or for hollow section, 35-50,000 psi; elong in 2 in., 2-5%; bhn, 35-45; sp gr, 6.4-7.2; nonmagnetic; weldability, fair; max cont serv temp, 275 F max; abrasion resistance, high. For bearing applications in all types of industrial and household equipment where lubrication is remote or likely to be neglected.

LEKTROKAST (Alloy iron casting) — Detroit Gray Iron Foundry, Detroit 7, Mich.
Furnished as sand castings to specifications.

Ts, 40-50,000 psi; Bhn, 200-240; weldability, fair. Used for dies (mainly deep drawing), gears, etc.

LEKTROMESH (Metal plated screening)—C. O. Jelliff Mfg. Corp., Southport, Conn.

One-piece solid metal-plated screen made by electrodeposition; 100 ft rolls up to 36 inches in width of 40-120 mesh; smaller units in 150-400 mesh; furnished in nickel and copper. For strainers in fuel systems, dry-screening, etc.

LENK SUPER ALUMINUM SOLDER — The Lenk Mfg. Co., Boston 15.

Solder furnished in rod 3/16-in. diam. by 17 in. long and in bars ⅝-in. square by 14 in. long. Low melting point; requires no acids or flux. Used for soldering aluminum to aluminum and aluminum to any metal that can be soldered.

LIGNUM-VITAE (Tropical wood) — Lignum Vitae Products Corp., Jersey City, N. J.

Natural tropical wood, 30 per cent volume is natural self-lubricating resin. Furnished in boards or logs for machining. Abrasion resistance, medium; resists corrosion caused by chemicals and light solutions; heat-resistant to 150 F; flexibility, low; moisture absorption, low; produced in natural colors; sp gr, 1.33; opaque; hardness, 3-4 Moh's scale; soluble in alcohol and acetone. For bearings, bushings, rollers, guides, etc., where lubrication is difficult or impossible.

LITHLEAD (Bronze)—Lithium Co., Newark 4, N. J.

Cu 64.6, Pb 35.4; furnished as ingots or pigs, rough bars or billets, as sand castings, permanent mold castings, precision castings, powder metal and finished bearings. Ts, 13,800 psi; comp str, 40,000 psi; elong in 2 in., 26.5%; Bhn, 27.1-28.4; nonmagnetic; max cont serv temp, 250 F. For bearings, brake linings, etc.

LITTITE (Alloyed gray iron)—Littite Foundries Inc., Port Huron, Mich.

As stress relieved: Ts, 30-35,000 psi; hardness, 196-228 bhn; machinability, good. A close-grained, non-porous iron suitable for a wide variety of cast machine parts.

LMC (Copper-base alloys) — Lewin-Mathes Co., St. Louis 2.

Pure electrolytic copper, brass and bronze mixtures, cupro-nickel; available in tubing. Used for all copper and brass tubing purposes.

LO-CRO (Stainless steels)—Crucible Steel Co. of America, New York.

Stainless steels in standard forms—Types 501 and 502. For property and application data on these, see "Stainless Steels" listing at end of this section.

LOF (Polished plate glass)—Libbey-Owens-Ford Glass Co., Toledo, O.

Heat-absorbing plate glass; furnished in sheet form; abrasion resistance, high; corrosion-resistant; heat absorbing; flexibility, medium; dielectric str, 0.204 kilovolts per mil; modulus of rupture, 6500 psi; moisture absorption, low; noninflammable; sp gr, 2.52; transparent; highly polished. For use where light transmission or vision is desired with insulation against solar radiation.

Polished plate glass; furnished in flat, bent and laminated form; in clear and colors; sp gr, 2.52; highly polished; high dielectric strength. Used for viewing windows.

LOGAN (Forging brass)—Titan Metal Mfg. Co., Bellefonte, Pa.

Cu 59, Pb 2, Zn balance. Ts, 57,000 psi; ys, 32,000 psi; elong, 32%; hardness, Rockwell 60 B. Machinability, excellent; corrosion resistance, fair.

LORD (Rubber-bonded-to-metal) — Lord Mfg. Co., Erie, Pa.

Rubber-bonded-to-metal, for a variety of uses including shear-type mountings for vibration isolation. Typical applications include aircraft, automotive, and marine engines; motors, pumps, compressors, general machinery, radio equipment, instruments, etc., where vibration is encountered.

LOUVERPLAS (Thermoplastic plastics)—The Doane Products Corp., Meriden, Conn.

Cellulose acetate, thermoplastic plastics in sheet form. In white and black and transparent; used for glare diffusing and for light control.

LUBRIK (Copper-tin-lead alloy) — Pittsburgh Brass Mfg. Co., Pittsburgh 1.

Cu 85, Sn 10, Pb 2½ and Zn 2½; furnished in rough bars or billets, for turning, boring, etc.; Bhn, 69. For heavy-duty bronze bearings. Hardened by addition of nickel.

LUCITE (Acrylic resin) — E. I. duPont de Nemours & Co. Inc., Plastics Dept., Arlington, N. J.

Methyl-methacrylate thermoplastic; furnished in sheets, rods, tubes and granules. Moldable into machine parts by all molding processes and by casting and extruding. Abrasion resistance, medium; chemical resistance; to water, weak acids and weak alkalies; not resistant to lower ketones, esters, aromatic hydrocarbons, strong acids, or strong alkalies. Max cont serv temp (unloaded), 190 F; flexural str, 12-16,000 psi (D790-44T); dielectric str, 400 volts per mil inst; ts, 7-9500 psi; impact str (Izod), 0.4-0.5 ft-lb; produced in unlimited colors, transparent, translucent, opaque; moisture absorption, medium; sp gr, 1.18; hardness, M87-M102 rockwell; coef of thermal expansion, 7.2-10.8 x 10^{-6} in./in./deg C. Used for guards, chemical tanks, enclosures, models, automatic heater and lubricator parts, etc.

LUKENS (Alloy steels) — Lukens Steel Co., Coatesville, Pa.

2% nickel steel; in plates and spun and pressed heads. Untreated: Ts, 65-80,000 psi; ys, ½ of ts; elong in 2 in., 25%; bhn, approx 140; for hot forging, stamping, hot or cold working, riveting, turning, boring, etc., into many types of machine parts where a high-tensile steel of good ductility for low temperature service is required.

Chrome-manganese steel; furnished same as above. Heat treated: Ts, 100-120,000 psi; ys, 65,000 psi min. Used principally in fan blades and fan rings or wherever any abrasion-resisting or high-stress properties are involved. For hot working.

3½% nickel steel; furnished same as above. Untreated: Ts, 70-90,000 psi; ys, ½ of ts; elong in 2 in., 25%. Used where good resistance to impact is desired in parts operating in sub-zero temperatures.

Manganese-vanadium steel; furnished in same as foregoing. Untreated: Ts, 90,000 psi max; ys, 45,000 psi min; elong in 2 in., 20%; high-tensile steel with good welding properties. Used in construction of anti-aircraft gun mounts and carriages as well as military tank parts.

Nickel-clad, Inconel-clad, Monel-clad and stainless-clad (straight chromium and chromium-nickel types) steels are all clad metals or bimetals consisting of a light layer of corrosion-resistant nickel, Inconel, Monel or stainless steel bonded to a heavier base plate of steel. For corrosion-resistant parts. In plates and heads.

Chromium-nickel-molybdenum steel; furnished in plates and heads. Untreated: Ts, 90-110,000 psi; ys, 50,000 psi; elong in 2 in., 20%; bhn, approx 195; magnetic; weldability, fair; abrasion resistance, high. For abrasion resisting parts at high temperatures where high stresses are involved.

Nickel-chromium steel; furnished in plates and heads. Untreated: Ts, 80-100,000 psi; ys, 50,000 psi, min; elong in 2 in., 20%; bhn, approx 140; magnetic; weldability, good; abrasion resistance, medium. For parts requiring good ductility.

0.50 molybdenum steel; furnished in plates and heads. Untreated: Ts, 65-80,000 psi; ys, ½ of ts; elong in 2 in., 25%; bhn, approx 140; magnetic; weldability, good; abrasion resistance, medium. For parts requiring high physical strength at high temperatures.

Chromium-copper-nickel steel; furnished in plates and heads. Heat treated: Ts, 65,000 psi, min; ys, ½ of ts; elong in 2 in., 25%; bhn, approx 140; magnetic; weldability, good; abrasion resistance, medium. For parts operating at low temperatures.

8½% nickel steel; furnished in plates and heads. Heat treated: Ts, 90-110,000 psi; ys, 70,000 psi min; elong in 2 in., 20%; bhn, approx 200; magnetic; weldability, good; abrasion resistance, medium. For parts operating at extremely low temperatures.

Chromium-molybdenum steel; furnished in plates and heads. Untreated: Ts, 70-90,000 psi; ys, 45,000 psi, min; elong in 2 in., 20%; bhn, approx 160; magnetic; weldability, good; abrasion resistance, medium. For high-strength parts requiring good heat resistance.

Manganese-vanadium-titanium steel furnished in plates and heads. Untreated: Ts, 85,000 max psi; ys, 45,000 psi min; elong in 2 in., 20% bhn, approx 175; magnetic; weldability, good; abrasion resistance, high. For marine applications, principally.

LUMARITH (Cellulose acetate base plastics)—Celanese Corp. of America, Plastics Div., New York 16.

Cellulose acetate base, thermoplastic; furnished in sheets, rods, tubes, and molding material for compression, injection and extrusion molding. Available in unlimited color range in a wide variety of formulations including heat and flame-resisting types; high polish; flexible; resistant to shock and corrosion. Used as interior electrical parts, instruments, air-craft lever knobs, electric insulation, steering wheels, automotive door and window handles, gas mask lens, etc.

Cellulose acetate base, thermoplastic; furnished in sheets and rolls or reels in thicknesses of 0.0007-0.20 for laminating, swaging, drawing or stamping into parts. Abrasion and corrosion-resistant; flexible; dielectric str, 700-2500 volts per mil; ts, 4500-11,000 psi; heat-resistant to 275 F; slow burning to nonflammable; transparent. Used for ammunition components, laminated slot insulation for motors; spirally wound tubing is used for insulating tool handles and interior electrical parts.

CA; cellulose-acetate base, for such applications as windows, cockpit enclosures, antennae housings, etc.; tough; has high clarity and optical uniformity– resistant to sunlight and can be heat-formed into three-dimensional shapes without surface impairment. Some of these materials are light stabilized having greater weather resistance; also for filtering out ultra-violet rays. It is abrasion-resistant.

LUMEN ALLOYS (Bearing bronzes) — Lumen Bearing Co., Buffalo 12 (Note: "Lumen Alloy," together with each of the following materials. Thus, "Lumen Alloy No. 00A," which should be used in specifying these numbers and grades is a copyrighted term etc.)

Nos. 00A and 00C; high tin bronzes for high compression bearing applications.

No. 1; zinc bronze for pressure castings including spur and bevel gears.

No. 2; zinc bronze for machine parts, bearings, etc.

No. 3; zinc bronze for mine service and paper mill machinery and bearings.

No. 4; phosphor bronze (leaded), for bearings.

No. 4 chill cast; for heavy-duty bearings, etc.

No. 4A; high-phosphorus bronze (leaded) for bearings on hard steel.

No. 5; general service casting alloy; red brass; for low pressure valve bodies, etc.

No. 7; phosphor bronze; uses include trolley wheels and castings to be nickel or chromium plated.

No. 9; manganese bronze for machine parts requiring strength, electrical conductivity, and high pressure.

No. 11-C; (sand cast) aluminum bronze; for miter, bevel gears and bearings subject to impact.

No. 11-C; (heat treated); ts, 65-100,000 psi; recommended where strength, corrosion and heat resistance are required.

No. 14; zinc bronze, babbitt backing; for valve bodies, etc.

No. 15; phosphor bronze; for worm wheels, bearings, etc.

No. 15 chill cast; for worm gears, nuts and bearings.

No. 15A; phosphor bronze (slightly leaded): for worm wheels, bearings, etc.

No. 15A; chill cast; for heavy-duty bearings and worm gear castings.

No. 20; super-manganese bronze; for machine parts requiring extra strength.

No. 31; for high-speed, low-duty bearings.

No. 33; for bearings, high-speed, low-duty.

No. 43; nickel-tin-bronze alloy for bearing, gears and nuts; abrasion-resistant.

No. 43 (Chilled); nickel tin bronze for bearings, worm gears and nuts with higher tensile strength than No. 43.

No. 48; nickel-phosphor-bronze; for bearings used with hardened steel, worm wheels, etc.

No. 48 chill cast; for bearings, worm gears, nuts, slippers, etc.

No. 54; phosphor bronze (leaded) for bearings and worm wheels for intermediate service.

No. 54 chill cast; for bearings, worm gears, nuts, etc.

No. 96; aluminum bronze, approximately 88 per cent Cu, 8.5 Al and 3.5 Fe; ts, 73,000 psi; ys, 25,000 psi; bhn, 114-121; sp gr, 7.7; and has medium abrasion resistance.

LUMITE (Industrial fabrics) — Chicopee Mfg. Corp. of Georgia, 47 Worth St., New York, N. Y.

Vinylidene chloride thermoplastics in woven fabric and braid; resistant to acid, most alkalies, solvents, oils and greases; max

cont serv temp, 225 F; flexural strength, good; dielectric strength (volts per mil. inst.), 500; ts, 25-40,000 psi; available in all colors; sp gr, 1.72; available translucent and opaque. These are fabrics woven of Dow Chemical Company's Saran and are used for straining, filtering, sieving, conveyor belts, etc.

LUSTREX (Polystyrene molding plastics)—Monsanto Chemical Co., Plastics Div., Springfield 2, Mass.

Flexural str, 9000-11,000 psi; sp gr, 1.05; dielectric constant; (1 megacycle), 2.5-2.7; power factor (1 megacycle), 0.0001-0.0005; water absorption (24 hours), 0.04-0.05%. No effect from weak acids and bases or strong bases; is attacked by strong oxidizing acids. Is soluble in esters, aromatics, higher alcohols, chlorinated hydrocarbons. Available in any color desired, in opaque, translucent or transparent.

LUSTRON (Styrene thermoplastic plastics) — Monsanto Chemical Co., Plastics Div., Springfield 2, Mass.

Styrene base; furnished in powder for molding into parts; abrasion resistance, fair; can be highly polished; corrosion-resistant; dielectric str, 500-700 volts per mil; ts, 6000-7000 psi; low moisture absorption; available in color; sp gr, 1.054-1.070; clear to opaque. Used for electrical insulating parts, etc.

LUZERNE (Hard rubber)—Luzerne Rubber Co., Trenton, N. J.

Hard rubber, thermoplastic; furnished in sheets, rods or tubes, for machining into parts; high polish; corrosion-resistant to acids and alkalies; dielectric str, 6 x 10^7 megohms constant at 28.8 C; ts, 3500-9000 psi; heat resistant to 120 F; available in some colors; sp gr, 1.24; comp str, 8000-12,000 psi. Used for electrical, chemical, medical and other parts requiring high dielectric strength.

M

M-13 (Magnesium-base die castings)—Precision Castings Co. Inc., Syracuse, N. Y.

Aluminum 9, manganese 0.13, zinc 0.6, silicon 0.5 max, with magnesium base; die castings; tensile strength, 33,000-34,000 lb per sq in.; yield point 21,000 lb per sq in.; elongation, 2 to 5 (3 av.) per cent in 1 or 2 inches; impact resistance, low; brinell hardness, 60; specific gravity, 1.81; nonmagnetic; corrosion resistance, fair; heat-resistant to 700 degrees Fahr.; abrasion resistance, medium.

MACHEMPITE (High strength castings)—Mackintosh-Hemphill Co., Pittsburgh.

C 0.3-1.25, Mn 1.25-1.75, Mo 0.25-0.75; furnished as castings, Ts, 85-125,000 psi; ys 65-100,000 psi; elong, 25-5%; impact resistance, low; bhn, 215-400; magnetic; weldability, good; abrasion resistance, medium. For gears, pinions, etc.

MACHINE-FACE (Welding rod) — American Manganese Steel Div. of American Brake Shoe Co., Chicago Heights, Ill.

C-Cr-Mn: For hard-facing only; as-welded hardness, bhn 325-350; flame hardens to 500-600 bhn; pearlitic steel deposits. Responds to flame hardening.

MAGIC IRON CEMENT—Magic Iron Cement Co., Cleveland.

A metal filler and adhesive made of powdered iron and binder. Used for plugging leaks in boilers, fire pots, etc., and for filling in pitted castings or any other pitted metals.

MAGIC PLASTIC BODY SOLDER—Magic Iron Cement Co., Cleveland.

Made of plastic resins, applied in putty form. Fast drying, easy to use. Used for filling in flaws, holes, etc., in metals.

MAGIC PLASTIC LEAD—Magic Iron Cement Co., Cleveland.

Made of plastic resins. Dries fast and has great strength. Used for caulking soil pipe joints, etc. Will withstand great pressure.

MAGICORES (Powder iron)—Henry L. Crowley & Co., West Orange, N. J.

High-frequency powdered iron cores for radio and electrical applications.

MAGNOLIA (Antifriction metal)—Magnolia Metal Co., Elizabeth, N. J.

Isotropic die cast bronze bar stock; Cu 80, Sn 10, Pb 10, and other alloys to suit conditions. Furnished in semifinished cored and solid bars, fully machined. Resists corrosion caused by acids; resists heat to 900 F; ts, 31,500 psi; comp str, 26,000; bearing properties, good; bhn, untreated, 70. Used for bearings.

AA Bronze: Isotropic die-cast bar stock for extremely tough bearing installations and for gears; bhn, 80; ts, 34,000 psi; elong in 2 in., 8 per cent. Furnished in cored and solid bars, fully machined.

Antifriction metal: Lead-base, less than 10 per cent of tin. For steady high speeds and heavy pressure. Keeps journals in good condition. Recommended also for electric motors above 10 hp. Bhn, 21.8.

MAIZEWOOD (Fiber insulation board)—Maizewood Insulation Co., Dubuque, Iowa.

Furnished in sheet form. Used as a sound deadener.

MAKEPEACE (Laminated precious metals)—D. E. Makepeace Co., Attleboro, Mass.

Laminated precious metals, consisting of any precious metals bonded to any nonferrous base metals, in strips (coiled), tubing, wire and sheets; for stamping, turning, boring, etc.

Sheet; available in any combinations of metals and ratio; single or double plate or strip. Can be produced as thin as 0.003-in.; in widths from ⅛-in. to 6 in.; and within tolerances of 0.0001-in. to 0.0002-in., depending on material. Available with fine mirrored finish suitable for fine precision parts or decorative pieces. Supplied coiled or flat, depending upon requirements, for any type of part.

Tubing; deep-drawn sheet; dimensional limits lie between approx. 0.015-in. OD to 2 in. OD, with wall thickness as small as 0.005-in., very close tolerances on wall thickness and diameters. Used in electrical industry, for electronic applications, radio parts, delicate instrument assemblies, etc.

Special shapes also available (rectangular, octagonal, or star-shaped, etc.). Rings, sleeves and jackets can be cut from laminated tubes.

Wire; diameters as fine as 0.005-in., depending on material; shaped for use. Available in any shape for instruments, for formed, plated springs, radio electronic parts and in chemical apparatus when corrosion must be prevented.

MALLIX (Pearlitic malleable iron) — National Malleable & Steel Castings Co., Cleveland.

For grate bars for sintering machines, elevator buckets, screen plates for pan mills and other castings subjected to heat, abrasion and shock.

MALLORY (High-copper and high-tungsten-base alloys)—P. R. Mallory & Co., Inc., Indianapolis.

3 Metals; a copper-chromium-lithium alloy; used extensively for spot, flash and seam welding cold-rolled steel, stainless steel, nickel alloys and Monel metal, silicon bronze alloys, zinc, nickel, silver and other materials employed in applications where a high-strength, high-conductivity material is required; available in rods, bars, strips and castings.

53B Metal; copper base alloy furnished in castings and forgings only; ts, 60-70,000 psi. Used for heavy-duty butt seam welding wheels, flash welding dies, bearings and current and heat-carrying members in electrical and other machinery.

73 Metal; rough and finished bars, sheets, castings and forgings; containing 95 per cent copper; resists sea water; ts, 110-170,000 psi. Used for bearings and bushings, vibrator arms, springs, spring washers and electrodes for projection welding.

100 Metal; rough and finished bars, castings and forgings, containing 95 per cent copper. Recommended for high loaded small gears, current-carrying bearings, springs and other details.

1000 Metal; predominantly tungsten; furnished in finished parts or blanks; ts, 100,000 psi; impact resistance, medium; hardness 32-40 rockwell C; sp gr, 16.9-17.1; nonmagnetic. Heat resistant up to 300 C; abrasion resistance, high. For small counter weights, gyroscope rings, etc.

MALTESE CROSS (Rubber) — Hewitt Rubber Div., Hewitt-Robins Inc., Buffalo 5.

Rubber for hose, belting and packing. Can be furnished extruded or for molding. Abrasion resistance, high. For use wherever hose, belting or packing are required.

MANGANAL (Welding rod)—Stulz-Sickles Co., Newark 5, N. J.

11-13½% manganese-nickel steel welding rod with tensile strength up to 155,000 psi and yield strength up to 60,000 psi. Used for repairing such items as shovel teeth, buckets, chutes, crushers, steel mill coupling boxes, tractor parts, etc.

MANGANWELD (Welding electrode) — Lincoln Electric Co., Cleveland.

Arc welding electrode that produces deposit of austenitic manganese-nickel-molybdenum steel. Suitable for hard facing austenitic manganese steel parts containing 11-14% manganese, such as crusher parts, valves, turbine runners, pulverizer roll shafts, gathering and loading equipment.

MANG-CO (Welding rod)—American Manganese Steel Div., American Brake Shoe Co., Chicago Heights, Ill.

C-Mn-Si: for buildup welding only on austenitic manganese or carbon steel; as-welded hardness, bhn 200; work hardens to 400-500 bhn. For building up quarrying, mining, excavating, and construction equipment wearing parts.

No. 459 (Welding rod); Cr-Mo-Ni-Mn-Si-C. For hard surfacing only; bhn, 500-600; resists most acids. Martensitic iron deposits; slightly magnetic; high abrasion resistance; mild impact. For hard facing machine parts subject to extreme abrasion and mild impact such as pug mill knives, mixer blades, brick dies, pulverizer hammers, muller tires, rolling mill guides, hog anvils, car retarded beams and parts, etc.

No. 217 (Welding rod); W-Cr-Mo-C; for hard facing only, bhn, 600-700; resists most acids; martensitic iron deposits, slightly magnetic, extreme abrasion resistance. For hard facing machine parts subject to extreme abrasion at normal and elevated temperatures up to 1000 F, such as conveyor screws, muller plows, coke pusher shoes, pick up shoes, rolling mill guides, carbon scrapers, pinch rolls, etc.

MARBLETTE (Plastics cast phenolic resin)—The Marblette Corp., L. I. City, N. Y.

Furnished in sheet, rod and tube form; abrasion resistance, medium; decomposes in strong alkalies; is slightly affected by strong acids; noninflammable; ts, 8-12,000 psi; moisture absorption, low; produced in unlimited number of colors; sp gr, 1.30-1.32; available transparent, translucent, and opaque; machinability, good. Used for knobs, handles, various trim parts, etc.

MARBON "S" (Thermoplastics)—Marbon Corp., Gary, Ind.

Modified styrene thermoplastic furnished in granules for injection and compression molding; abrasion resistance, high; max cont serv temp, 120 F; flexural str (ASTM D 650-42T), 8000 psi; dielectric str (volts per mil inst), 1035-1060; ts, 5400 psi; available in the color amber; moisture absorption, low; sp gr, 1.05; translucent; machinability, good.

MARCOLITE (Plastics laminates)—Marco Chemicals Inc., Sewaren, N. J.

Polyester thermosetting laminates having excellent chemical resistance, low moisture absorption, and good machinability.

MARQUETTE (Welding rods, brazing compounds and solders)—Marquette Mfg. Co. Inc., Minneapolis.

A complete complement of welding rods, brazing compounds and solders as follows:

No. 130 Red rod and No. 140 Production rod: Meets AWS Spec E 6011.

No. 151 White rod: Meets AWS Spec E 6013.

No. 101 Dust Cote rod: Meets AWS Spec E 4511. These welding rods (ac-dc) are used in the fabrication of sheet metal, pipe, tanks, boilers, structural steel, trucks, cars, farm equipment, etc.

No. 31 Positive rod: Meets AWS Spec E 6010.

No. 25 Negative rod: Meets AWS Spec E 6012.

No. 33 Hot rod: Meets AWS Spec E 6020. These are mild steel welding rods for joining all types of mild steel structures.

No. 9 aluminum rod is made of 43S aluminum. No. 8 aluminum rod is made of 2S aluminum. No. 80 and No. 70 flux coated aluminum rod is made of 43S aluminum. No. 716 aluminum brazing rod used for low temperature brazing. No. 803 aluminum solder has high tin content. These rods are used for welding and brazing aluminum and aluminum alloys.

No. 85 Hy-test rod: Meets AWS Spec 8011. No. 110 Hy-test rod meets AWS Spec E 10011; No. 2512 nickeloy rod. These are chrome-moly-nickel alloy steel rods (ac-dc) used for welding low-alloy, high-tensile steels.

No. 308 Stain rod (ac-dc); Available in all types of stainless steel. Used for joining steels, high-alloy-content steels, high carbon steels, and armour plate.

No. 100 hard rod; No. 250 Mang rod; No. 450 hard rod; No. 550 hard rod; No. 650 tool rod. These are ac-dc rods used for all types of hard surfacing.

No. 1175: Silver solder; used for joining various ferrous and nonferrous metals.

Alladin die cast rod: Used for joining zinc or aluminum die castings.

Gas welding rod: No. 20, Tobin Bronze; No. 30, low fuming manganese bronze; No. 35, silicon bronze; No. 1301, phosphor bronze; No. 37, Monel rod; No. 32, flux coated brazing rod.

Ferrous gas welding rods: No. 1 and 2, mild steel; No. 3, high tensile rod; No. 4, 1% carbon steel rod; No. 5, cast iron rod; G 2512, 5% nickel rod; G 308, Type 308 stainless rod. For joining all types of steel, cast iron and stainless steels.

No. 44, Nicol rod: An ac-dc welding rod which gives machinable welds on cast iron, etc.

No. 42 cast rod: An ac-dc welding rod of cast iron.

No. 40 Blu-rod: Has a steel core wire for cast iron welding.

No. 61 bronze rod: A metallic arc rod for ac-dc brazing.

MARVEL (Hot-work die)—Vanadium Alloys Steel Co., Anchor Drawn Steel Co., Colonial Steel Div., Lathrobe, Pa.

C 0.35, W 10.00, Cr 3.50, V 0.50, Si 0.25 and Mn 0.25. Furnished in rough bars and billets, finished rods or bars, wire, sheet, plate, forgings and drill rod; for machining, hot and cold working, stamping, drawing and brazing. In heat-treated state: Comp str 40,000 psi; impact str, Charpy (unnotched), 40-60 ft-lb; hardness, rockwell C, 46 max; sp gr, 8.2; magnetic, max cont serv temp, 1150 F; abrasion resistance high. For wearing parts used at high temperatures and subject to shock, high temperature springs, etc.

MAX-EL (Alloy steels)—Crucible Steel Co. of America, New York.

1-B; C 0.20, with high Mn and low Mo; excellent machining and uniformly in carburizing response. Used for automobile parts, machine tool parts, gages, sprockets, etc.

2B; C 0.40 and otherwise identical in analysis to 1-B. Used in "as-rolled" condition for machine tool spindles, lead screws, racks, worms, piston rods, etc.

3½; for heat-treated parts on machine tools, such as gears, arbors, spindles, etc.

4; this steel is used primarily for collets, pushers, rolls, spindles and toggle pins.

Also producers of high speed steels, tool steels and die steels under many trade names.

MAYARI R (Low-alloy, High-strength steel)—Bethlehem, Pa.

Alloy iron made directly from nickel-chromium bearing ores, used in the production of quality castings.

MAYARI R (Low-alloy, High-strength steel) — Bethlehem Steel Co., Bethlehem, Pa.

Meets requirements for ASTM A-2421. Resists atmospheric corrosion and abrasion. Used for many types of light-weight construction. Furnished in sheets, plates, bars, structural shapes, rivets and bolts.

MAZLO (Magnesium alloys)—American Magnesium Corp., 2210 Hardvard Ave., Cleveland.

Available in sand, permanent-mold and die castings, extruded bar, shapes and structural sections, and forgings.

AM230; Al 10, Si 0.7, Mn 0.2, Mg remainder. Used for pressure die castings for parts requiring light weight and thin sections.

AM260; Al 9, Zn 1, Mn 0.2, Mg remainder. Heat-treatable alloy sand and permanent-mold castings. For moving parts on high-speed production equipment and wherever pressure tightness and good strength are needed. Good salt water resistance.

AM265; Al 6, Zn 3, Mn 0.2 remainder. Used for high-strength sand castings requiring good chemical stability.

M263; Al 9, Zn 0.6, Mn 0.2, Mg remainder. Used for pressure die castings for light-weight parts in portable or fast-moving equipment.

AM38; Mn 1.5, Mg remainder. For extruded shapes, sand castings, and hammer forgings of moderate strength for uses requiring maximum salt water resistance. Suitable for fabricated articles such as aircraft oil tanks and cowlings.

AM-C52S; Al 3, Zn 1, Mn 0.2, Mg remainder. Used for extrusions of light weight. Good welding and forming characteristics and salt water resistance.

AM-C57S; Al 6, Zn 1, Mn 0.15, Mg balance. Used for extruded bars, tubes and for light-weight applications in general.

AM-C58S; Al 8, Zn 0.8, Mn 0.15, Mg remainder. Used for hot press forgings for parts under stress, especially for aircraft and aircraft engines.

AM59S; Al 10, Mn 0.15, Mg remainder. Used for extruded shapes in which highest possible hardness and yield strength in tension is required.

AM65S; Al 3.5, Sn 5, Mn 0.5, Mg remainder. Used for hot press forgings of moderate strength and lightness.

MCA (Alloying elements)—Molybdenum Corp. of America, Pittsburgh.

Ferro-Boron: alloying material in irons and steels. In castings its use gives increased strength and machinability, and in the case of malleable iron, ease of annealing.

Molybdenum: alloying element for use in steel and iron; imparts strength, toughness, ductility and resistance to abrasion; improves fatigue value, eliminates temper embrittlement, increases physical properties at elevated temperatures; molybdenum steel is easily welded and machined.

Tungsten: alloying element for steel; imparts hardness, resistance to abrasion; cutting ability to tool steels. Used extensively as tungsten carbide where special cutting service is desired.

MD (Metal powders)—Metal Disintegrating Co. Inc., Elizabeth B, N. J.

Alloy aluminum antimony, bismuth, brass, bronze, cadmium, chromium, copper, iron, lead, manganese, nickel, silicon, silver, solder, tins, and zinc metal powders; compositions impossible to obtain by conventional methods. For powder metallurgy fabrication, welding, rod manufacture, solder paste manufacture, shot peening, blasting, abrasion, pigmentation, chemical uses.

MECOBOARD (Thermosetting plastics) — Continental-Diamond Fibre Co., Newark 23, Del.

Phenol-formaldehyde, thermosetting; furnished in sheets, rods, and tubes for compression molding. Abrasion resistance, medium; max cont serv temp, 220 F; flexural str, 22,000 psi (ASTM D-229-42); dielectric str, 475 volts per mil; ts, 9500 psi; comp str, 31,000 psi; impact str, 6.5 ft-lb (Izod); moisture absorption, low; translucent; machinability, good. Used for electrical insulation.

MEEHANITE METAL (Sorbo-pearlitic iron)—Meehanite Metal Corp., New Rochelle, N. Y. and foundries as listed hereunder.

Contains silicon, magnanese, phosphorous, sulphur and carbon, composition depending upon mixture and physical constitution as determined by service requirements; twentyfour grades, some of which can be heat treated, and flame hardened, each having a separate and distinct combination of physical properties; available in cast form; for machinery and miscellaneous castings.

Foundries include the following: American Brake Shoe Co., Mahwah, N. J.; American Laundry Machinery Co., Rochester, N. Y.; Atlas Foundry Co., Detroit; Banner Iron Works, St. Louis; Barnet Foundry & Machine Co., Irvington, N. J.; E. W. Bliss Co., Toledo, O. and Hastings, Mich.; Builders Iron Foundry, Providence, R. I.; H. W. Butterworth & Sons Co., Bethayeres, Pa.; Cincinnati Grinders Inc., Cincinnati; Cincinnati Milling Machine Co., Cincinnati; Continental Gin Co., Birmingham, Ala.; Cooper Bessemer Corp., Grove City, Pa. and Mt. Vernon, O.; Crawford & Doherty Foundry Co., Portland, Oreg.; M. H. Detrick Co., Newark, N. J.; The Elliott Co., Jeannette, Pa.; Farrel-Birmingham Co., Ansonia, Conn.; Florence Pipe Foundry & Machine Co., Florence, N. J.; Fulton Foundry & Machine Co., Cleveland; General Electric Co., Ontario, Calif.; General Foundry & Mfg. Co., Flint, Mich.; Greenlee Foundry Co., Chicago; Hamilton Foundry & Machine Co., Hamilton, O.; Johnstone Foundries Inc., Grove City, Pa.; Kanawha Mfg. Co., Charleston, W. Va.; Koehring Co., Milwaukee; Lincoln Foundry Corp., Los Angeles; E. Long Ltd., Orillia, Ont.; The Newark Stove Co., Newark, O.; Otis-Fensom Elevator Co. Ltd., Hamilton, Ont.; Henry Perkins Co., Bridgewater, Mass.; Pohlman Foundry Co., Buffalo, N. Y.; Prescott Foundry Co., Menominee, Mich.; Rosedale Foundry & Machine Co., Pittsburgh; Ross Meehan Foundries, Chattanooga, Tenn.; Shenango-Penn Mold Co., Dover, O.; Standard Foundry Co., Worcester, Mass.; Stearns-Roger Mfg. Co., Denver, Colo.; Traylor Engineering & Mfg. Co., Allentown, Pa.; Valley Iron Works Inc., St. Paul; Vancouver Engineering Works, Vancouver, B. C.; Vulcan Foundry Co., Oakland, Calif.; Warren Foundry & Pipe Corp., Phillipsburg, N. J.; Washington Iron Works, Seattle; Washington Machinery & Supply Co., Spokane, Wash.

MELMAC (Melamine formaldehyde plastics)—Plastics Division, American Cyanamid Co., New York 20.

1502; a cellulosic-filled, melamine formaldehyde plastics; thermosetting; furnished in granules for compression or transfer molding. Chemical resistance, good; flexural strength (ASTM D650-42T), 9000-10,000 psi; dielectric strength (volts per mil inst), 350-400 at room temperature; ts, 6000 psi; imp str, Izod, 0.40; moisture absorption, low; sp gr, 1.43; is opaque, machinability, good; coefficient of thermal expansion, 21-43 x 10^{-6}. Used for electrical insulation where arc resistance and track resistance are required.

1077; alpha-cellulose filled, melamine formaldehyde thermosetting plastics for transfer or compression molding. Abrasion resistance, high; chemical resistance, good; max cont serv temp, 210 F; is noninflammable; flexibility, low; dielectric strength (volts per mil inst), 310-315 at room temperature; ts, 7-8000 psi; comp str, 40-45,000 psi; moisture absorption, low; available translucent to opaque in all colors; is shatterproof; sp gr, 1.5; machinability, good; hardness, Rockwell E 100-110; coefficient of thermal expansion 20-57 x 10^{-6}. Used for housings, lighting reflectors, etc.

3020; melamine formaldehyde, thermosetting; furnished in particles for compression or transfer molding. Has high chemical resistance; max cont serv temp, 240 F; flexural str, 14,000 psi; dielectric str, 270 volts per mil; impact str 0.68 ft lb (Izod); available in white, green, blue, red, brown black and ivory; moisture absorption, low; sp gr, 1.4; opaque. Used for electrical insulation where arc resistance is required (plus shock resistance).

MESH-TECH (Plywood)—Technical Ply-Woods, Chicago 1, Ill.

Consists of a thin three-ply panel, phenolic bonded, less than 1/16-in. thick. Faces are carefully chosen veneers of mahogany, walnut or maple. The core is a thin sheet of vulcanized material of high dielectric strength, tough, hard, dense, and light in weight. On completion panels are fed through a die and perforated. Has great strength for its weight. For radio grills, air conditioning panels, interiors of buses, airplanes and railroad coaches where light weight is a factor.

METAL & THERMIT (Welding electrodes)—Metal & Thermit Corp., New York City.

Stainless; Types 19-9, 347, 18-8, Mo, 25-20, 25-20 N, and 310 ac-dc. For welding food, chemical and refinery processing equipment, acid container linings, valve seats, turbine blades, heat exchangers, dies, etc.

Chrome-Moly Types; Type 2110 and 2115. For welding chrome-moly and other high-strength piping and pressure vessel cast fittings.

Copper-Aluminum (Bronze) Types; AB-12, AB-16, AB-20, AB-25, and AB-30. For built-up bearing surfaces, bronze casting repairs, repair of motor end rings, piston rods, pump parts, locomotive guides, parts of dissimilar materials, ship propellers, marine fittings, etc.

Copper-Tin (Bronze) Type; AB-57. Uses similar to those of above.

Types A, AWL, CW, FHP, F, HTS, M, MA, N, O, U, 90, 8015 Q, are for general machine-part fabrication and repair including drive shafts, auto springs, machine bases, etc.

METALINE (Bearing alloy)—R. W. Rhoades Metaline Co. Inc., Long Island City, N. Y.

Lubricating insert plugs of several diameters and lengths and in varied compositions for rendering bronze bearings and bushings oilless. Also bronze bearings, complete in which Metaline plugs are inserted, furnished as finished bearings.

METCO-WELD H (Powdered hard-facing alloy)—Metallizing Engineering Co., Inc., Long Island City, N. Y.

A "wire" composed of a powdered hard-facing alloy extruded with a plastic binder; applied by metal spraying, subsequent fusing with a fusing torch results in a coating alloyed to the base metal which is physically and chemically identical to hard-facing the same alloy applied by other methods. Hard facing is extremely resistant to abrasion and corrosion, has high strength and exceptional resistance to oxidation.

MICABOND (Mica material) — Continental-Diamond Fibre Co., Newark 23, Del.

A built-up mica material; furnished in sheets and tubing, for machining and forming into parts. Bonded together with shellac or synthetic resins to provide high dielectric and heat and moisture-resistant properties. Available in two types; standard, for general use, and super for special applications requiring unusually high heat resistance and dielectric strength. Each type is produced in a number of grades for specific applications. Used for V-rings, washers, segments and various special shapes.

MICANITE (Built-up mica)—Mica Insulator Co., Schenectady, N. Y.

Furnished in sheets, tapes and tubes. Used for electrical insulation on commutator rings, appliance heating element patterns, slot cells, and core, coil and busbar insulation, etc.

MICARTA (Thermosetting plastics) — Westinghouse Electric Corp., Trafford, Pa.

Melamine formaldehyde base and phenol formaldehyde base; furnished in laminated sheet, rods, and tubes. Abrasion resistance, high; chemical resistance, good up to 15% solutions; max cont serv temp, 105-130 C; flexural strength (ASTM D 650-42T), 10,000-27,000 psi; dielectric strength (volts per mil inst), 100-600; ts, 6,000-16,000 psi; comp str, 8000-40,000 psi; furnished in black and natural; is opaque; hardness, Rockwell M, 98-122. For variety of industrial applications such as gears, cams, panels, dials, etc.

MICHIANA (Heat-resisting cast alloys)—Michiana Products Corp., Michigan City, Ind.

Zorite; 35 Ni-15 Cr alloy. Properties as cast; Ts, 63,500 psi; ys, 36,500 psi; elong in 2 in., 5.2%; reduction of area, 6.1%; bhn, 168. Used for castings operating at elevated temperatures.

No. 100 Alloy; 25 Cr-12 Ni alloy. Properties as cast; Ts, 70,500 psi; ys, 40,100 psi; elong in 2 in., 14.5%; reduction of area, 15.4%; bhn, 166. Used for castings operating at elevated temperatures.

Fire Armor "B"; 60 Ni-13 Cr alloy. Properties as cast; Ts, 65,800 psi; ys, 33,800 psi; elong in 2 in., 4.5%; reduction of area, 5.5%; bhn, 181. Used for castings operating at high temperatures.

MICHIGAN (Seamless tubing)—Michigan Seamless Tubing Co., South Lyon, Mich.

Cold-drawn; of standard carbon and alloy steels and of special alloys to customers' requirements. Available in rounds, squares and special shapes. For aircraft, pressure and mechanical uses.

MICRO-ROLD (Stainless steel sheet and strip)—Washington Steel Corp., Washington, Pa.

Precision cold rolled stainless steel sheet and strip up to 36 inches wide in Types 301, 302, 304, 321, 347 in gages from 0.078 to 0.004 inch.

MIDVALE (Steels)—The Midvale Co., Nicetown, Philadelphia 40.

Forgings, weldless rings, any analysis (carbon, alloy or stainless steel), hardened and ground steel rolls, heat and corrosion resistant castings, cast-to-shape tool steel and bar steel (carbon, high speed and alloy tool steel), also stainless bars.

MIDVALOY Hi-C Hi-Cr (Cast-to-shape tool steel)—The Midvale Company, Nicetown, Philadelphia 40, Pa.

Furnished as sand castings. In annealed state, Bhn, 210-240; in hardened state, Rockwell C 59; weldability, poor; abrasion resistance, high. Machines readily; distorts very little and is nearly immune from cracking during heat treatment. Used wherever abrasion and wear resistance is an important requirement. Used for dies, blanking, beading, cams, cutting, drawing, extrusion and knurling tools.

MIN-OX (Heat-resisting castings)—The Binney Castings Co., Toledo 7, O.

Castings for molds, valves, plungers, neck rings and other necessary mold parts for production of glass. Also known as Binney Metal.

MISCO METAL (Stainless steels) — Michigan Steel Casting Co., Detroit 7, Mich.

For data on types, properties, characteristics and applications see "Stainless Steels" listing at end of this section.

MM (Steel castings)—The Bonney-Floyd Co., Columbus 7, O.

C 0.25-0.35, Mn 1.20-1.40, Mo 0.15-0.25. Recommended heat treatment, quench at 1600 F in water; temper 500 F to 1325 F. Ts, 90,000-180,000 psi; ys 60,000-165,000 psi; elong in 2 in., 6-25%; Bhn, 179-420; sp gr, 7.86; magnetic; weldability, good; abrasion resistance, medium. Used for highly stressed machine parts.

MOCCASIN (Bronze alloys)—Moccasin Bushing Co., Chattanooga, Tenn.

Various bronze alloys furnished as rough castings, solid or cored bars, finished machined bars, and plain and special bushings.

MOGUL (Babbitt)—Federal Mogul Corp., Detroit.

Mogul alloy genuine babbitt; made from tin, antimony and copper, virtually lead free; hard, tough alloy; high tensile strength; suitable for die-cast and hand-poured bearings. Used for high-speed automobile and aircraft engine, steel and bronze back main and connecting-rod bearings, trucks, tractors, high-speed machinery, planers, etc.

Mogul bearing metal; general all-purpose babbitt for bearings requiring toughness. Used for machinery bearings, stationary gas engines, paper mill rolling mill, rubber plant and brick machinery.

407 nickel babbitt; varying slightly from Mogul genuine babbitt alloy. For applications where speed is fairly high and bearings are large, that is, 1/16th-inch or more in thickness. Used in woodworking machinery and other heavy-duty types.

408 special babbitt (copper-hardened); originally produced for electric railway armatures, now used for special bearing applications; has great durability and will stand up under hard wear. Used in motor pumps, motor shafts, rock crushers, forming presses.

Duro antifriction metal; while softer and less tough than Mogul bearing metal (above), compares favorably with lead-base general purpose babbitts. Used for flour mill, laundry, canning and bottling machinery, pump packing, slow-moving pulleys, etc.

Special "B"; a lead and antimony alloy; free of usual nonbearing ingredients. Used for slow-speed bearings and heavy line shafting.

MOLEX (Molding plastics)—Molex Products Co., Chicago 6, Ill.

Bituminous and asbestos thermoplastics compound fabricated by injection and compression molding. Abrasion resistance, low; max cont serv temp, 186 F; dielectric str, (volts per mil inst.), 205 after immersion in water 24 hours; ts, 2000 psi; comp str, 10,000 psi; produced in black only; moisture absorption, very low; sp gr, 1.61; is opaque; machinability, fair. For electric insulators, terminal blocks, receptacles, structural blocks, radiator valve wheels, etc.

MOLEX (Arc welding electrode) — Metal & Thermit Corp., New York 5.

For low-alloy, high-strength machine parts. Weld deposit: ts, 70-75,000 psi; ys, 57-66,000 psi; elong in 2 in., 22-31%.

Type R; arc welding electrode for use in shipbuilding, pipe fabricating, refineries, etc. Weld deposit: Ts, 63-75,000 psi; ys, 54-61,000 psi; elong in 2 in., 22-31%.

Type S; arc welding electrode for sheet metal fabrication in automotive work, storage tanks, railroad cars, road and farm machinery. Weld deposit: Ts, 71-75,000 psi; ys, 62-64,000 psi; elong in 2 in., 20-26%.

MOLIN METAL (Aluminum-bronze alloys) — Dirilyte Co. of America Inc., Kokomo, Ind.

Furnished as permanent-mold castings and forgings to specifications.

No. 2: In untreated condition: Ts, 74,000 psi; elong in 2 in., 9%; bhn, 140-150; weldability, good; abrasion resistance, high. For welding machine fixtures, bearings, etc.

No. 2½: In heat-treated condition: Ts, 67,000 psi; elong in 2 in., 3%; bhn, 180-200; weldability, good; abrasion resistance, high. For welding machine fixtures, bearings, acid bath hooks, etc., which require higher hardness than that offered by Molin Metal No. 2.

No. 3: In untreated condition: Ts, 50,000 psi; elong in 2 in., 4%; bhn, 200-220; weldability, fair; abrasion resistance, high. For wiping dies, die plates, welding machine fixtures, etc.

MOLYBDENUM (Alloying element) — Climax Molybdenum Co., New York 18, N. Y.

Alloying element for use in steel and iron. Imparts strength, toughness, ductility and resistance to abrasion; improves fatigue value, eliminates temper brittleness, improves physical properties at elevated temperatures.

MOLYBDENUM PERMALLOY (Electrical steel)—Allegheny Ludlum Steel Corp., Brackenridge, Pa.

A nickel-molybdenum-iron alloy of high permeability. Must be dry hydrogen annealed after fabrication. Furnished in finished rods or bars, coiled strip, wire, sheets. Used as a magnetic core material in special audio transformers, instruments and for magnetic shields.

MOLY-TELASTIC (Alloy cast steel)—The Falk Corp., Milwaukee, Wis.

C 0.30-0.40, Mn 1.00-1.50, Mo 0.15-0.25. Furnished in sand castings to specifications. In heat treated state, ts, 100,000-200,000 psi; ys, 70,000-160,000 psi; elong in 2 in., 25-12%; endurance limit, 45-50% of tensile strength; Bhn, annealed, 160; 200-400, heat treated. Used for gears, crusher parts, ex-

cavating equipment and similar heavy duty services.

MO-MANG (Welding rods)—American Manganese Steel Div., American Brake Shoe Co., Chicago Heights, Ill.

Manganese welding rod: C-Mn-Si-Mo; for build-up welding austenitic manganese steel castings and rolled shapes; as-welded hardness, bhn 200; work hardens to 450-500 bhn. Austenitic steel deposits nonmagnetic; highly resistant to impact, wear and abrasion. For build-up welding on dipper lips, hammer mill parts, dredge pump shells, stone crusher equipment, etc.

Nickel-manganese welding rod: C-Mn-Ni-Si; for welding austenitic manganese steel castings and rolled shapes; as-welded bhn, 200; work hardens to 450-500 bhn; austenitic steel deposits nonmagnetic. For autenitic manganese steel frogs, crossings, dippers, dipper teeth repointers. Also quarrying, logging, oil, construction, mining, steel mill and excavating equipment wearing parts.

MO-MAX (High-speed steel) — The Cleveland Twist Drill Co., Cleveland 14, Ohio.

A high-speed steel, in rough bars or billets, finished rods or bars, wire and sheets, for hot forging, turning, boring, welding, etc. Resists heat to 1100 F; high abrasion resistance; high ts; good bearing properties; sp gr, about 7.95; weldability, good; bhn, untreated, 220; heat-treated 700. For use where great strength and wear resistance up to temperatures of 1000 F are required, such as gears, cams, guides, wearing plates, etc. Licensees are: Allegheny Ludlum Steel Corp., Atlas Steel Ltd. (Canada), Bethlehem Steel Co., Braeburn Alloy Steel Corp., Carpenter Steel Co., Columbia Tool Steel Co., Crucible Steel Co. of America, Henry Disston & Sons Inc., Firth-Sterling Steel Co., Halcomb Steel Co., Jessop Steel Co., Latrobe Electric Steel Co., The Midvale Co., Universal-Cyclops Steel Corp., Vulcan Crucible Steel Co., Simonds Saw & Steel Co., and Vanadium-Alloys Steel Co.

MONARCH (High-lead bronzes)—Monarch Alloys Co., Ravenna, O.

In several different grades, produced by water-chilled process; furnished in rough bars in 2-ft lengths. Good bearing qualities and good machinability. Also produce bronze and aluminum sand castings.

MONARCH (Rubber) — Hewitt Rubber Div., Hewitt-Robins Inc., Buffalo 5.

Rubber for hose, belting and packing. Can be furnished extruded or for molding. Abrasion resistance, high. For use wherever hose, belting or packing are required.

MONEL (High nickel-copper alloys)—The International Nickel Co. Inc., New York.

Monel Wrought Forms; various tempers of rod and bar, cold-drawn wire, hot-rolled plate, cold-rolled sheet and strip, and seamless tubing. Property ranges: Ts, 70-170,000 psi; ys, 25-160,000 psi; elong in 2 in., 50-1 per cent; bhn, 110-375. Corrosion resistance, high. For propeller shafts, pump shafts and rods, impellers, bolts, rivets, etc., orifice plates, tanks, electrical contact parts, springs, carburetor parts, strainers, screen, filters, etc.

Monel Castings; In untreated state: Ts, 65-90,000 psi; ys, 32-40,000 psi; elong in 2 in., 45-25 per cent; bhn, 125-150. Slightly magnetic; weldability, good; abrasion resistance, medium; max cont. serv. temp, 800 F (under load); corrosion resistance, high. For pump casings, impellers, filter plates, valve bodies, trim, bushings, fittings. Widely used where corrosion resistance is an important factor as in laundry, pickling, tanning, marine, chemical, oil-processing, paint and food-processing equipment.

"K" Monel; furnished in rod and bar, strip and wire in various forms and tempers; non-magnetic. Range of properties: Ts, 90-200,000 psi; ys, 40-145,000 psi; elong in 2 in., 45-2 per cent; bhn, 140-320. Corrosion resistance, high. For marine pump shafts, wearing sleeves, oil-pump drop and seat-valves, valve disks and pump rods, ball-bearing races, balls and cones, roller chain, link studs, check-valve balls, wire springs, etc.

"KR" Monel Wrought Forms; available in rod and wire only. Composition same as "K" Monel. Has better machinability than K.

"R" Monel Wrought Forms; furnished in rod and bar, cold-drawn wire, cold-rolled strip, seamless drawn tubing. Range of properties: Ts, 65-170,000 psi; ys, 25-160,000 psi; elong in 2 in., 50-1 per cent; bhn, 110-375. Corrosion resistance, high. Machinability, better than Monel. For parts requiring good corrosion and abrasion resistance combined with free-cutting qualities.

"H" Monel Castings; Untreated: Ts, 90-115,000 psi; ys, 60-80,000 psi; elong in 2 in., 20-10 per cent; bhn, 175-250 nonmagnetic; weldability, poor; abrasion resistance, medium; max cont. serv. temp, 800 F (under load); corrosion resistance, about same as Monel. For parts similar to those for which regular Monel is suitable, but where better abrasion and erosion resistance is required, plus higher strength, as for steam nozzles.

"S" Monel Castings; Heat treated: Ts, 110-145,000 psi; ys, 80-115,000 psi; elong in 2 in., 4-1 per cent; bhn, 300-375; nonmagnetic; weldability, poor; abrasion resistance, high; max cont. serv. temp, 1100 F (under load); corrosion resistance, about same as regular Monel. Parts, similar to those for which regular Monel is suitable, but where top resistance to galling and erosion are needed, as for valve seats, etc.

MONIMAX (Electrical steel)—Allegheny Ludlum Steel Corp., Brackenridge, Pa.

A high nickel-molybdenum steel having good permeability at moderate flux densities. used in low and intermediate density high-frequency cores.

MORAINE (Porous metal)—Moraine Products Div., General Motors Corp., Dayton, O.

Filtering and diffusing material, product of powder metallurgy in bronze, and other metals; provides high flow rates, low flow resistance; used in fuel and lubricating systems, instruments, breathers, burners, separators, etc.

MORGANITE (Carbon-graphite) — Morganite, Inc., Long Island City, N. Y.

Carbon-graphite, and carbon-graphite-metal mixtures; in finished rods or bars and plates, for turning, boring, molding, etc. Resists corrosion caused by any liquid handled industrially; resists heat to 700 F; good abrasion resistance; ts, 1000-3000 psi; comp str, 10-30,000 psi; ductility, low; sp gr, 2-2.15. Used for bearings, valves, seals, nonfriction slides, piston rings, etc.

MOSIL (Alloy tool steel)—Vanadium Alloys Steel Co., Anchor Drawn Steel Co., Colonial Steel Div., Latrobe, Pa.

C 0.55, Si 1.90, Mn 0.85, Cr 0.25, Mo 0.33. Furnished in rough bars or billet, finished rods or bars, wire, sheet, plate, forgings, and drill rod; for permanent-mold castings, precision casting; machining, hot and cold working, stamping, drawing and brazing. In heat-treated state: Hardness, rockwell C, 62-63 max; magnetic; abrasion resistance, medium. For shanks, chisels, dogs, shears, etc.

MR (Plastic resins) — Marco Chemicals Inc., Sewaren, N. J.

Polyester thermosetting resin furnished in liquid form for castings. Has excellent corrosion resistance; low moisture absorption; and good machinability.

MRCO (Metal powders)—Metals Refining Co., Hammond, Ind.

40 RL; Cu 99.4; all passing in a 40-mesh sieve, not over 20 per cent passing a 200-mesh screen; has apparent density of 2.5 grams per cu cm. Used in commutator brushes, chemical porous filters, catalyzers, and pressed metal compositions.

100 RXA; Cu 99.4; all passing a 100-mesh screen; not over 45 per cent passing a 325-mesh screen; has apparent density of 2.7 grams per cu cm. Used in porous metal bearings, intricate pressed metal shapes, electrical commutator brushes, etc.

150 RXA; Cu 99.4; all passing a 150-mesh sieve, not over 75 per cent passing a 325-mesh sieve; has apparent density of 2.75 grams per cu cm. For same applications as 100 RXA.

200 RL; Cu 99.4; all passing a 200-mesh sieve, and not less than 85 per cent passing a 325-mesh sieve. Used in chemical equipment, special commutator brushes, porous bearing compositions; also has advantages for copper brazing and coating welding rods.

500 RL; Cu 99.4; all passing a 325-mesh sieve, and substantially all particles are less than 15 microns in diam. For use where extremely fine particle size is desired, in brazing and coating, as clutch facings, etc.

I-100; Fe 96 min; all passing a 100-mesh sieve; and 25-45 per cent passing 325-mesh sieve; has apparent density of about 1.8-2.0 grams per cu cm. For pressed parts such as clutch facings, gears, filters, etc.

I-120; Fe 96 min; all passing 100-mesh sieve and 30-50 per cent passing 325 mesh. Has apparent density of 2.3-2.5 grams per cu cm. Same uses as I-100.

I-147; Fe 96.5 min; all passing 40 mesh sieve and 10-20 per cent passing a 325-mesh sieve. Has apparent density of 1.8-2.0 grams per cu cm. Same uses as I-100.

I-247; Fe 97 min; apparent density 2.65-2.85 grams per cu cm; all passing a 40-mesh sieve with 10-20 per cent passing 325-mesh sieve; hydrogen-annealed for pressed ferrous metal compositions and electrical parts requiring high priority iron.

MUELLER 600 (Bearing metal)—Mueller Brass Co., Port Huron, Mich.

Cu 56-60, Pb 0.5 max, Mn 1.25-3.5, Al 0.5-2, Si 0.5-1.2, Fe 0.6 max, and remainder Zn. Sold as extruded and drawn, and rods and bars, and as die forgings from rod. Ts, 70-85,000 psi; ys, (½ per cent extension) 45-50,000; elong in 2 in., 20 to 10 per cent for die forgings. Sp gr, 8.071; conductivity about 12 per cent of copper; nonmagnetic; good corrosive resistance against sea water. Used as low speed heavily loaded bearings as it withstands damage from lubricants carrying considerable sulphur compounds. Also used for high-speed bearings on hardened mating surfaces, cam faces and machine parts subject to wear, such as pump rods and shafts, and forged connecting rods for high-speed.

MULTIPLATE (Laminated bullet-resisting plate glass)—Pittsburgh Plate Glass Co., Pittsburgh 19.

Multiple laminated plate glass, Vinyl plastic binder; furnished in cut sizes and shaped. Corrosion and abrasion resistance, high; shatterproof; transparent; highly polished. For protection against high velocity missiles.

MULTI-WEAVE (Special composite materials)—General Electric Co., Electronics Dept., Syracuse, N. Y.

Material made up by inter-weaving strands, strips, etc., of metals, plastics, wood, rubber, fabrics, etc., or combinations thereof. Produced to specifications. Used for ventilating grilles, decorative panels, gratings, bulkheads, air-conditioning grilles, guards, refrigerator trays, cigarette cases, display fixtures, etc.

MUMETAL (Electrical steel)—Allegheny Ludlum Steel Corp., Brackenridge, Pa.

A very high permeability nickel-copper-chromium-iron alloy, that must be very high-temperature, dry-hydrogen annealed after fabrication. Sold principally in form of sheet, strip, bar and laminations, also shields. For special electrical instruments and transformers requiring highest performance.

MYCALEX (Glass-bonded mica)—Mycalex Corp. of America, Clifton, N. J. Also General Electric Co., Chemical Dept., Pittsfield, Mass.

Furnished in sheets ⅛ to 1 in. thick, 14 x 18 in.; in rods 18 in. long, ¼ to 1 in. diameter. Abrasion resistance, medium; is unaffected by most liquids except acid solutions; max cont serv temp, 750 F; is nonflammable flexibility, low; dielectric str, (volts per mil inst.), 400; ts, 6000 psi; comp str, 35,000 psi; transverse str, 15,000 psi; moisture absorption, 0; produced in gray and brown; sp gr, 3; is opaque; machinability, good; Bhn, 50; coefficient of thermal expansion 101 x 10^{-7} in. per in. per degree C. For low-loss high-frequency insulators, terminal plates, precision moldings, arc and oil resistant parts.

N

NA, NA-1, NA-2 (Alloy steel castings) — National Alloy Steel Division, Blaw Knox Co., Blaw Knox, Pa.

Alloy steels having varying percentages of nickel and chromium.

NACO (Special cast steel)—National Malleable & Steel Castings Co., Cleveland.

For service where heavy blows and constant friction require a material that combines great strength, toughness and resistance to wear. Used in chains for steam shovel, dragline, draft gears, railway equipment.

NATIONAL (Carbon or graphite)—National Carbon Co., Inc., New York 17.

Molded, extruded or machined into practically any shape. Highly resistant to most acids, alkalies and solvents. Has low coefficient of thermal expansion and resists thermal shock. Good electrical conductivity. In graphitic form carbon possesses excellent lubricating properties and good thermal conductivity. Used for bearings, packings, electric current conductors, structural members and linings in the chemical and metallurgical industries. Available in blocks, brick, tile, beams, slabs, cylinders, and tubes.

NATIONAL FIBRE—National Vulcanized Fibre Co., Wilmington, Del.

Converted cotton cellulose, chemically pure, tough horn-like material; furnished in hard or flexible form in sheets, rolls, tubes, rods and fabricated shapes; high dielectric and mechanical strengths; resistant to abrasion and shock; easily formed and machined; light in weight. Used for gears, valve disks, gaskets, washers, bobbin heads and electrical insulation, etc.

NATIONAL (Graphitic steel)—National Malleable & Steel Castings Co., Cleveland.

High-strength steel furnished in castings. Has medium abrasion resistance; ts, 75,000 psi min; can be flame hardened; avg bhn, 200. Used for automotive and other medium-size castings requiring high strength and good machinability.

NATIONAL (Metals) — National Bearing Div., American Brake Shoe Co., St. Louis 10.

Various nonferrous centrifugal and precision castings, babbitt metals and precision bearings. Castings produced to specification.

397 Babbitt: Furnished in bars; ts, 9500-10,000 psi; used primarily for bearing linings.

Diesel Engine Babbitt: Tin-base; furnished in bars, ts, 11,000 psi at 1% deformation; used primarily for bearing linings.

NATIONAL (Powder metal)—National Molded Products Inc., St. Marys, Pa.

Cu 90, Sn 10; furnished in powder; nonmagnetic; corrosion-resistant; heat-resistant to 400 F; abrasion-resistant. For bearings or intricate parts.

NATIONAL - STANDARD (Wire, braided wire and tape)—National - Standard Co., Niles, Mich.

Wire braids flat and tubular of steel or other metal.

Tapes and specialized wire products for tire beads, steam hose armor, reinforcement for oil well drilling hose, braided covering for flexible tubing.

Standard wire for reinforcing flat and V-belts.

Braided covering for electrical cables.

Drawn wire in small sizes down to 0.002-in. of steel, aluminum, brass, Monel, nickel silver, stainless steel, phosphor bronze and other alloys.

NATIONAL SWITCH INSULATION—National Vulcanized Fibre Co., Wilmington, Del.

Combination laminated Bakelite core with vulcanized fiber surfaces; available in sheets and fabricated shapes; high tracking (arc) resistance combined with rigidity and minimum warpage; high dielectric and mechanical strengths; low moisture absorption; easily stamped and fabricated. Used in switches to support and insulate current-carrying parts.

N-A-X (High-strength low-alloy steel) — Great Lakes Steel Corp., Div. of National Steel Corp., Ecorse, Mich.

9100 Series; C 0.1-0.7, Mn 0.6-0.75, P 0.040 max, S 0.05 max, Si 0.6-0.9, Cr 0.5-0.65, Mo 0.1-0.2, and Zr 0.05-0.15. Furnished in rough bars or billets, finished rods or bars, strips (coiled), sheets and plates, for forging, stamping, turning, boring, etc. Recommended heat treatment: Quench and draw—carburizing grades treated by regular conventional methods.

High tensile; C 0.12, Mn 0.70, Si 0.80, Cr 0.60, S 0.030, P 0.025, and Zr 0.10. Furnished in rough bars or billets, finished rods or bars, strips (coiled), tubing, wire, sheets and plates for stamping and welding. No subsequent treatment needed after hot working. Good stability and ductility permit it to be cold-formed; good impact resistance; high fatigue resistance; good welding properties. Used for machine parts where high torsional properties, high tensile strength and resistance to fatigue and notch impact at normal and subzero temperatures are required.

NEILLITE (Phenolic plastics)—Watertown Mfg. Co., Watertown, Conn.

Thermosetting material: furnished in powder form and granules for molding into parts; abrasion resistance, medium; resists corrosion caused by weak acid and alkali; dielectric str, 375-400 volts per mil; ts, 5500-7500 psi; comp str, 22,200-32,600 psi; moisture absorption, low; nonflammable; available in colors; shatterproof. For switch cases, spacers, gears, cams; knobs, etc.

NELOY (Cast steels)—National Erie Corp., Erie, Pa.

Medium manganese cast steel and medium manganese plus molybdenum alloy content cast steels; rough finished, machined or flame hardened. High strength and hardness due to combination of alloying and special hardening. Has high abrasion resistance. Used for various applications in rolling mills and steel works equipment, overhead traveling cranes, power shovels, drag lines, etc.

NEMALOY (Aluminum alloy castings)—National Bronze & Aluminum Foundry Co., Cleveland.

No. 9; Si 4.50-6.00, low impurities, balance Al; furnished as sand or permanent-mold castings. In untreated state: Ts, 19,000 psi; comp str, 10,000 psi; ys, 9000 psi; elong in 2 in., 5.0 per cent; impact str, 1.0 ft-lb (Charpy); endurance limit (completely reversed bending), 6500 psi; bhn, 40; sp gr, 2.70; nonmagnetic; weldability, good; max cont. serv. temp, 250 F. For various corrosion resisting parts.

No. 50; Cu 8.0, Fe 1.0, Si 1.2, balance Al; furnished as sand and permanent-mold castings. In untreated state: Ts, 23,000 psi; comp str, 14,000 psi; ys, 14,000 psi; elong in 2 in., 2.0 per cent; impact str, 0.6 ft-lb (Charpy); endurance limit (completely reversed bending), 8000 psi; bhn, 65; sp gr, 2.83; max cont. serv. temp, 250 F; nonmagnetic. For general purpose castings.

No. 54; Cu 4.0, Mg 1.5, Ni 2.0, balance, Al; furnished as sand and permanent-mold castings. In heat-treated state: Ts, 37,000 psi; comp str, 47,000 psi; ys, 32,000 psi; sp gr, 2.77; nonmagnetic; weldability, good; max cont. serv. temp, 350 F; abrasion resistance, high. For parts subjected to elevated temperatures.

No. 64; Si 7.0, Mg 0.3, balance Al; furnished as sand and permanent-mold castings. In heat-treated state: Ts, 33,000 psi; comp str, 22,000 psi; ys, 24,000 psi; elong in 2 in., 4.0; sp gr, 2.68; nonmagnetic; weldability, good; abrasion resistance, medium; max cont. serv. temp. 300 F. For intricate parts requiring high strength.

No. 105; Cu 4.0, balance Al; furnished as sand castings. In heat-treated state: Ts, 36,000 psi; comp str, 25,000 psi; ys, 24,000 psi; elong in 2 in., 5.0; impact str, 1.8 ft-lb (Charpy); sp gr, 2.78; nonmagnetic; weldability, good; max cont. serv. temp, 300 F. For castings where design is not intricate and high strength is needed.

NEOPRENE (Chloroprene synthetic rubber)—E. I. du Pont De Nemours & Co., Inc., Arlington, N. J.

Available for hose, wire, cable, sheets, tank lining, gaskets, packing, tubing, belting diaphragms, industrial truck tires and molded goods. Used as binder for cork and asbestos. Is employed to impregnate or coat canvas, duck or other fabrics. Strength, abrasion resistance, resilience and elasticity of rubber: resistance to deterioration from contact with oils, greases, gasoline, heat chemicals, sunlight and ozone; corrosion-resistant; will not support combustion; low moisture absorption; ts 4000 psi; available in colors. Used for machine applications where rubber characteristics are required but where the product is to be subjected to deteriorating influences.

NEW JERSEY ZINC (Brass, Bronze and copper powder metals)—The New Jersey Zinc Co., New York.

Brass Powders; all common brasses furnished in powder metal. Ts, 29-35,000 psi; comp str, 31-43,000 psi; ys, 8500-18,800 psi; elong in 2 in., 11-50%; impact str, 11-27 ft lb (Charpy); Bhn, 35-51.

Bronze Powders: Both spherical and irregular; for brazing, spraying and compacting.

Spherical Copper Powder; resists corrosion caused by oils and lubricants. Used for filters.

NEY-ORO-G (Gold-platinum-silver-copper alloy)—The J. M. Ney Co., Hartford, Conn.

In wire, sheets, coil strip and plate; for stamping, turning, boring, welding and soldering. Mechanical properties in heat-treated state: Ts, 160,000 psi; ys, 154,000; elong, 6 per cent; impact resistance, high; bhn, 280; non-magnetic; weldability, good; abrasion resistance, medium. For pivots, small bearings, springs and electrical contacts.

NICHROME-NICHROME V (High nickel-chrominum alloy)—Driver-Harris Co., Harrison, N. J.

Ni 60, Cr 16, balance Fe, and Ni 80, Cr 20, respectively. High-temperature heat resistant and electrical resistant. Heating element material for domestic electrical appliances, electrical furnaces, ranges, also misc. elec. resistors. Castings for high-temperature furnace parts; also sheet, tubes, rod, strip and wire.

NICKEL—International Nickel Co. Inc., New York.

Nickel; Ni 99.4, Cu 0.1, Fe 0.15, Mn 2, Si 0.05, C 1, S 0.005; rustproof, corrosion-resistant; chemical, radio and electronics parts.

L Nickel; a low-carbon type of nickel, otherwise similar in chemical composition to nickel. Especially suitable in contact with fused caustic and certain fused salts.

D Nickel; Ni 95.2, Cu 0.05, Fe 0.15, Mn 4.5, Si 0.05, C 0.1, S 0.005. A metal similar to nickel but affording superior mechanical properties and resistance to atmospheric attack at elevated temperatures; corrosion and heat-reistant; for electrical uses.

Z Nickel; Ni 93.7, heat-treatable material resembling nickel except for its higher mechanical properties which are comparable to those of oil-tempered spring steel; corrosion resistant. Used for products requiring spring properties with corrosion resistance.

Nickel Castings; Untreated; ts, 45-60,000 psi; ys, 20-30,000 psi; elong in 2 in., 30-15 per cent; bhn 85-125; magnetic; weldability, good; abrasion resistance, medium; good corrosion resistance. For chemical and food-processing equipment parts.

NICKEL-ARC (Welding electrodes)—Alloy Rods Co., York, Pa. Welding electrodes for welding cast iron.

NICKELOID (Nickel bonded to zinc)—American Nickeloid Co., Peru, Ill.

Nickel bonding serves as rustproof, flexible and inexpensive white metal base. Available in variety of brilliant finishes and patterns, as sheets, flat strips and coiled strip for continuous feed automatic presses. Can be supplied with quick removable, gum-adhered paper covering, permitting drawing and forming without marring prefinish.

NI CLAD (Nickel clad copper rod and wire)—Alloy Metal Wire Co., Inc., Prospect Park, Pa.

Nickel clad copper wire, 34% cross sectional area in nickel shell covering, balance is copper. Furnished in finished rods or bars and wire. In cold worked state, ts, 80-90,000 psi; ys 20-30,000 psi; elong in 2 in., 10-29%; hardness, Rockwell B, 80-90, sp gr, 9; magnetic; weldability, good; max cont serv temp, 1000 F; abrasion resistance, medium.

NICLOY (Steel tubes)—The Babcock & Wilcox Tube Co., Beaver Falls, Pa.

Nicloy 3½: C 0.20 max, nickel 3.25-9.75; high strength alloy; for corrosion-resisting services particularly in alkaline media in chemical processing; excellent low-temperature

properties for service in oil dewaxing, refrigeration; for service to —320 F.

Nicloy 5: C 0.14 max, nickel 4.75-5.25; high strength alloy; for corrosion-resisting services particularly in alkaline media in chemical processing; excellent low-temperature properties for service in oil dewaxing, refrigeration; for service to —320 F.

Nicloy 9: C 0.12 max, nickel 8.00-10.00; high strength alloy; for corrosion-resisting services particularly in alkaline media in chemical processing; excellent low-temperature properties for service in oil dewaxing, refrigeration; for service to —320 F.

NICROMOL (Welding electrodes) — Erickson Electronic Sales Co., Rockford, Ill.

SAE 4130 alloy, chrome-moly. Available in rods 3/32, ⅛ and 5/32-in. diameter; coated with flux containing titanium dioxide. For welding aircraft frames, motor supports, tractors and similar steel and cast-iron parts.

NICUITE (Bearing nickel-bronze)—A. W. Cadman Mfg. Co., Pittsburgh.

Nickel-bronze; Sn 10, Ni 3.5, Zn 2.5, trace of P, balance Cu; high comp str. For bearings operating at slow or medium speeds under extreme pressures.

NI HARD (Martensitic nickel cast iron)—International Nickel Co. Inc., New York.

Type 1 Regular Sand Cast; total C 3-3.6, Si 0.40-0.60, Mn 0.40-0.60, S 0.15 max, P 0.40 max, Ni 4.25-4.75, Cr 1.40-2.50. Ts 40-50,000 psi; Bhn, 550-650; magnetic; weldability, poor; abrasion resistance, very high. For parts such as grinding balls, ball and roll mill liners, pump parts, pug mill knives and other abrasion-resistant parts of mining, power, cement, ceramic, paint, coal, coke, and foundry equipment.

Type 1 Regular Chill Cast; composition same as above. Ts, 50-60,000 psi; Bhn, 600-725; magnetic; weldability, poor; abrasion resistance very high. For same type parts for which Type 1 Regular Sand Cast is suitable.

Type 2, High-Strength, Sand Cast; total C 2.90 max, Si 0.40-0.60, Mn 0.40-0.60, S 0.15 max, P 0.40 max, Ni 4.25-4.75, Cr 1.40-2.50, Tc, 45-55,000 psi; Bhn, 525-625; magnetic; weldability, poor; abrasion resistance, very high. Parts same as for the Reglar Sand Cast Type, but for greater strength and toughness.

Type 2, High-Strength Chill Cast; Compositon same as Type 2, Sand Cast; ts, 60-75,000 psi; Bhn, 575-675; magnetic; weldability, poor; abrasion resistance, very high. For parts same as those for which Regular Ni Hard is suitable, but where greater strength and toughness are required.

NI-HARD (Welding rod)—American Manganese Steel Div., American Brake Shoe Co., Chicago Heights, Ill.

C-Si-Ni-Cr: For hard facing only; bhn, 500-600; martensitic iron deposits, magnetic; for hard surfacing parts subject to extreme wear and medium impact.

NIKOH (Steel, tube, pipe and conduit)—Nikoh Tube Co., Chicago 32.

Mild steel of SAE 1010 and 1025 analyses; furnished in tubing and pipe. Machinability and weldability are good. Material is suitable for bending, flanging, expanding, etc.

NIKRO (Alloy tool steel)—Vanadium Alloys Steel Co., Anchor Drawn Steel Co., Colonial Steel Div., Latrobe, Pa.

C 0.70, Mn 0.55, Si 0.30, Cr 0.85, Ni 1.40, and Mo 0.40. Furnished in rough bars or billets, finished rods or bars, wire, sheet, plate, forgings and drill rods; for machining, hot and cold working, stamping, drawing, brazing and forging. Hardness, rockwell C, 62 max; magnetic; abrasion resistance, medium. For spindles, etc.

NILVAR (Low-expansion nickel steel)—Driver-Harris Co., Harrison, N. J.

A 36% Ni steel having the lowest coefficient of expansion to 392 F of any alloy. Used for thermostatic controls in heating apparatus such as electric ovens, laboratory ovens, gas ovens, oil burners, and house heating apparatus.

NI-RESIST (Austenitic nickel cast iron)—International Nickel Co. Inc., New York.

Type 1; Total C 3.00 max, Si 1-2.5, Mn 1-1.5, Ni 13.5-17.5, Cu 5.5-7.5, Cr 1.75-2.5. As cast, ts, 25-30,000 psi; Bhn, 130-160; nonmagnetic; wedlability, fair; abrasion resistance, medium; max cont serv temp, 1300 F; good corrosion resistance. For pipes, pump parts, heat exchangers, etc., where corrosion resistance, elevated-temperature resistance, or high electrical resistance is required.

Type 2; Total C 3.00 max, Si 1-2.5, Mn 0.80-1.5, Ni 18-22, Cu 0.50 max, Cr 1.75-2.5. As cast, ts, 25-30,000 psi; Bhn, 130-160. Possesses same properties and is used for same applications as Type 1.

Type 3; Total C 2.75 max, Si 1-2, Mn 0.40-0.80, Ni 28-32, Cu 0.50 max, Cr 2.5-3.5. Ts, 25-35,000 psi; Bhn, 120-150; magnetic; weldability, fair; max cont serv temp, 1300 F. For corrosive applications or moderately high-temperature applications involving severe thermal gradients.

Type 4; Total C 2.60 max, Si 5.0-6.0, Mn 0.40-0.80, Ni 29-32, Cu 0.50 max, Cr 4.5-5.5. Ts, 25-35,000 psi; Bhn, 150-180; slightly magnetic; weldability, fair; abrasion resistance, medium; max cont serv temp, 1500 F. For food processing equipment where stain resistance is desired.

Type 5 (Minovar Iron); Total C 2.40 max, Si 1-2, Mn 0.40-0.80, Ni 34-36, Cu 0.50 max, Cr 0.10 max. Ts, 20-25,000 psi; Bhn, 100-125; magnetic; weldability, fair; for machine tool gages, scientific and optical instruments, glass molds, paper dies and equipment where low thermal coefficient of expansion is required.

NIREX (Acid-resistant alloy) — Driver-Harris Co., Harrison, N. J.

Ts, annealed, up to 95,000 psi; spring temper 180,000; supplied in finished rods or bars, wire, sheets and strip; also can be fabricated by sand casting. For use where corrosion and heat resistance, and spring properties will be useful.

NI-SPAN (Constant-modulus alloy) — International Nickel Co., Inc., New York.

C; Ni 41-43 Ti 2.2-2.6, Cr 5.1-5.7, C 0.06 max, Mn 0.30-0.60, Si 0.30-0.80, Al 0.40-0.80, P 0.04 max, S 0.04 max, Fe balance. Furnished in rough bars and billets, finished rods and bars, straight and coiled strip, and wire. Ts, 90-200,000 psi; ys, 35-180,000 psi; elong in 2 in., 40-7 per cent; Bhn, 145-395; slightly magnetic; weldability, good. A constant-modulus alloy for springs used in accurate scales, tuning forks, bourdon tubes, diaphragms for altimeters, strain gages.

NI-SPAN C (Ti-Cr-Ni alloy)—H. A. Wilson Co., Newark 5, N. J.

A titanium-chromium-nickel alloy having a constant modulus, adjustable through heat treatment.

NI-TENSYLIRON (Nickel alloy cast iron)—International Nickel Co. Inc., New York.

Ni 1-6, total C 2.5-3.15, Si 1.2-2.75, Mn 0.5-0.9. Ts, 40-70,000 psi; bhn, 200-300; magntic; weldability, fair; wear resistance, good.

High-strength cast iron for machine tool castings, diesel engine housings, crankshafts, dies, cylinder blocks, pistons, etc.

NITRALLOY (Nitriding steel)—Nitralloy Corp., New York.

Controls nitriding process and licenses under which alloy is produced. A chromium-molybdenum-aluminum steel capable of developing extreme hardness through nitriding; for cams and camshafts, gears, pump parts, splined shafts, cylinder liners, etc. Licensees include Allegheny Ludlum Steel Corp., Bethlehem Steel Co., Firth-Sterling Steel Co., Republic Steel Corp., Rotary Electric Steel Co., The Timken Roller Bearing Co., Vanadium Alloys Steel Co., Copperweld Steel Co., Atlas Steels Ltd., The Babcock & Wilcox Tube Co., and Carnegie-Illinois Steel Corp.

NITRON (Cellulose nitrate plastics)—Monsanto Chemical Co., Plastics Div., Springfield 2, Mass.

Thermoplastic; furnished in sheets, or in laminated form for machining, molding, stamping, swedging or blowing (steam) into parts; corrosion resistant; translucent; available in colors; flexible; dielectric str, 600-1200 volts per mil; ts, 5000-10,000 psi; low moisture absorption. Used for sight glasses, safety handles and structural models for strain study.

NIXON C/A (Cellulose acetate plastics)—Nixon Nitration Works, Nixon, N. J.

Furnished in sheets, rods, tubes and granules for injection and compression molding and extruding. Abrasion resistance, high; soluble in ketones and esters, slightly soluble in alcohol, little affected by hydrocarbons. Max cont serv temp, 160 F; flexural str, 4-15,000 psi (ASTM D 650-42T); dielectric str, 290-400 volts per mil; ts, 4-11,000 psi; comp str, 10-30,000 psi; impact str, 0.25-0.35 ft lb (Charpy), and 1.0-4.2 ft lb (Izod); available in colors; moisture absorption, low; sp gr, 1.27-1.56.

NIXON C/N (Cellulose nitrate plastics)—Nixon Nitration Works, Nixon, N. J.

Thermoplastic; for molding, machining, stamping and forming into parts. Abrasion resistance, medium; resists corrosion caused by water, hydrocarbons, diluted alkalies and acids; heat resistant to 160 F; flexible; dielectric str, 300-500 volts per mil; ts, 6000-9000 psi; com str, 20-30,000; moisture absorption, low; produced in color; shatterproof; sp gr, 1.39-1.45; transparent, translucent and opaque; machinability, good; Bhn, 8-11. For handles, knobs, nameplates, etc.

NIXON E/C (Ethyl cellulose plastics)—Nixon Nitration Works, Nixon, N. J.

Thermoplastic; furnished in sheet, rods, tubes, and granules for injection molding, blow molding, and extruding. Abrasion resistance, medium; is affected slightly by weak acids; decomposes in strong acids; max cont serv temp, 140-200 F; flexural str (ASTM D 650-42T), 9000-10,000 psi; dielectric str, (volts per mil inst.), 470-550; ts, 2,500-8000 psi; unlimited color possibilities in transparent, translucent and opaque; moisture absorption, low; sp gr, 1.08-1.18; machinability, good; good dimensional stability; good toughness and strength; low-temperature shock resistance. For motor housings, electrical appliances, etc.

NORCELL (Ethyl-cellulose plastic) — Norrell Inc., Memphis 12, Tenn.

RX76: Thermoplastics; furnished in blocks for casting and dipping. Abrasion resistance, low; chemical resistance, excellent to acids and alkalies; soluble in organic solvents; max cont serv temp, 150 F; produced opaque in all colors except pure white; moisture absorption, low; sp gr, 0.97. For potting and coating of electrical coils and condensers. Also for coating mechanical parts to protect them against damage and corrosion.

Strippable: Thermoplastic; furnished in blocks. Chemical resistance, excellent to acids and alkalies; soluble in organic solvents; max cont serv temp, 130 F; ts, 350 psi; produced transparent in amber; moisture absorption, low; sp gr, 0.97. This is a hot-dip, strippable coating for protection of precision parts in storage and shipment.

NOVO SUPERIOR (High-speed steel)—H. Boker & Co., Inc., N. Y. C.

An 18-4-1 (W, Cr, V) steel with maximum red hardness and wear resistance. Used for punches, broaches, cutters, knives, reamers, drills, etc.

NUBRAZE (Silver brazing alloys)—Sherman & Co., New York 13, N. Y.

Contains silver, copper, cadmium and zinc in varying percentages; furnished in straight and coiled strip, wire and powder metal. For repairing broken tool bits, hobs, milling cutters, etc. Also for mounting carbide tips.

NUREX (Alloy steel castings)—National Malleable & Steel Castings Co., Cleveland.

A chromium-manganese-carbon alloy furnished in castings. Resists corrosion caused by dilute aqueous solutions and acids (except phosphoric). Resists heat to 1700 F. Abrasion-resistant. Used for mill balls, lining and similar purposes.

NYLON (Polyamide thermoplastic)—E. I. du Pont de Nemours & Co. Inc., Plastics dept., Arlington, N. J.

Available in sheets, rods, tubes, granules, and filaments. Fabricated into parts by injection molding, transfer molding, extruding and machining. Max cont serv temp, depends on type, highest about 400 F; flexural

str, various types, 3800-14,600 psi; dielectric str, 385-420 volts per mil inst; ts, 7400-10,900 psi; produced in natural and a few colors; moisture absorption, medium; sp gr, 1.09-1.14; is translucent in thin layers, opaque in heavy layers; machinability, good; hardness (various types), Rockwell R83-R118. Is tough, abrasion-resistant, easily molded into complicated and delicate shapes; heat-resistant; sterilizable. Used for coil forms, impact devices, sheathing on insulation, light-load, low-speed gears, and bearings.

O

OHIO (Carbon and carbon-graphite)—Ohio Carbon Co., Cleveland 11.

Carbon furnished in rods or plates. Abrasion resistance, medium; chemical resistance, high; max cont serv temp, 400-500 F; flexibility, low; ts, 2275 psi; comp str, 7-9000 psi; transverse str, 6500 psi or more; moisture absorption, low; available in black and natural; machinability, fair. For bearings such as slow speed bearings and thrust bearings, seals for pumps, etc.

OHMALOY (Electrical steel) — Allegheny Ludlum Steel Corp., Brackenridge, Pa.

A steel for high electrical resistance applications, such as motor starters, crane motor controls, and mine locomotive controls. Available in all forms. Approx. analysis—Cr 12, Al 4½, Fe bal.

OHMOID (Phenolic plastics)—Wilmington Fibre Specialty Co., Wilmington 99, Del.

Thermosetting; furnished in laminated sheets, rods and tubes, for machining or stamping into parts; dielectric str, 200-700 volts per mil; moisture absorption, 2%; insoluble in ordinary solvents; high polish; corrosion-resistant; ts, 10-14,000 psi; heat resistance, 250-300 F. Used for electric and mechanical insulation.

OILITE (Powder metals)—Chrysler Corp. Amplex Div., Detroit 31.

Oilite bronze bearings; heavy duty self-lubricating precision bronze bearings; 25% oil by volume. Wide ranges of sizes in plain, flange, thrust, self-aligning bearings. Used extensively in aircraft, motor vehicles, farm implements, home appliances, electrical equipment, textile machinery, food processing and packing machines, etc. Available in cored, bar, and sheet stock.

Super-Oilite; a porous, oil-cushion, extreme-pressure, self-lubricating iron alloy bearing. Allowable static bearing load, 22,000 psi. High oil content, strength and ductility. Furnished in finished bearings and in cored, solid, and plate stock.

Super-Oilite 16; a porous, oil-cushion, extreme high pressure self-lubricating bearing. For high loads at low velocities. Extreme hardness combined with high oil content, for static bearing loads up to 100,000 psi.

Iron Oilite; a porous, pure iron (copper free), oil-cushion, self-lubricating bearing. Resistant to chemical and corrosive actions, particularly of sulphur and its compounds. Used especially for bearings in pumps.

Oilite Machine Parts; eliminate machining. Made by powder metallurgy processes from nonferrous and ferrous alloys. Wide range of physical properties. Reduce tool-up time and cost.

Oilite Filter Materials; for filtering, metering, diffusing, flame-arresting, and other uses. High flow with low resistance. Calibrated porosity. From variety of metals and alloys.

Oilite Friction Materials; powder metallurgy products. High heat conductivity. Uniform friction qualities. Resistant to high temperatures and to glazing and wear. For clutch, brake, and other applications.

OILWAY (Die steel)—H. Broker & Co., Inc., New York.

Die steel containing C 0.94, Si 0.33, Mn 1.23, W 0.57, and Cr 0.44. Furnished in bars, drill rods and forgings. As cast, ts is 150,-000 psi; in bar stock form, 200,000 psi. Comp str 350,000 psi. For all types of dies, gages, reamers, broaches and punches.

OLDS BEARING BRONZE (High leaded nickel-bronze)—Olds Alloys Co., Southgate, Calif.

Furnished in ingot form and sand castings; in heat treated state; ts, 38,000 psi; ys, 28,-000 psi; elong in 2 in., 8-12%; impact str (Izod), 5-7 ft-lb.; sp gr, 9.2; nonmagnetic; weldability, fair; max cont serv temp, 400 F; abrasion resistance, medium to high. For general bearings subjected to heavy loads and high speeds.

OLDSMOLOY (Cr-Ni-Mo-bronze)—Olds Alloys Co., Southgate, Calif.

Furnished in ingot form and sand castings to specification; in normalized state; ts, 80,000 psi; ys, 47,000 psi; elong in 2 in., 15-20%; Bhn, 160-170; sp gr, 8.4; nonmagnetic; weldability (gas), good; max cont serv temp, 500 F; abrasion resistance, medium to high. Used for parts in food and chemical machinery of all kinds, for heavily loaded bearings, pintle and detachable chains.

ORCO (Natural and synthetic rubbers)—Ohio Rubber Co., Willoughby, O.

All natural and synthetic rubbers furnished in sheet, channel, strip, tubing and special shapes. Also molded and extruded parts and rubber-to-metal parts to specification.

OREIDE (0.5% tin brass)—Scovill Mfg. Co., Waterbury 91, Conn.

Cu 89.5, Sn 0.5, balance Zn; available in strip, rod, wire and tubing. Has excellent cold working characteristics and a gold color, making it particularly suitable for costume jewelry, novelties, buckles, clips and other such commercially fabricated products. Ts, 63,000 psi (hard); density, 0.318 lb per cu in.; recommended annealing temperature range, 800-1350 F (425-725 C).

ORNAMETL (Wood veneer on steel)—Haskelite Mfg. Corp., Grand Rapids 2, Mich.

Veneer on steel, is furnished in sheets for stamping, rolling and pressing. Semi-inflammable; moisture absorption, low; available in mahogany, walnut and birch veneers; shatterproof; machinability, good. Used for airplanes, busses, street cars, railways, etc.

ORRWELD (Welding rods)—Orrweld Inc., Pittsburgh 12.

Complete line of welding electrodes and acetylene welding rods.

OSTUCO (Precision tubing) — Ohio Seamless Tube Co., Shelby, O.

Seamless and electric-welded. Formerly known as Ohio Specialty Quality tubing.

OTISCOLOY (Special high-tensile steel)—Jones & Laughlin Steel Corp., Pittsburgh 30.

A high-tensile steel, light in weight, good weldability and formability; resistant to abrasion and atmospheric corrosion. For use in cars, trucks, buses, mine cars, etc.

OXWELD (Welding rods)—Linde Air Products Co., New York 17.

No. 6 C. M. steel rod; for making high-strength welds in base materials which are to be heat-treated after welding such as aircraft parts containing carbon manganese, silicon, molybdenum and chromium. Can also be used for building-up hard and wear-resisting surfaces on pressure rolls, shovel teeth, grinding mills and similar applications.

No. 32 C. M. S. steel rod; for high-strength and high-speed welding of pressure vessels, tanks and steel pipe. This rod produces welds with a tensile strength of between 75,000 and 90,000 psi. Speed of application, which reduces gas consumption, is a feature of this rod.

No. 14 drawn aluminum rod; for sheet aluminum, and aluminum-manganese alloys. Conventional drawn aluminum rod for welding pure sheet aluminum where high strength is not required.

No. 25M flux-coated bronze rod; precoated with Brazo flux during manufacture. Combines qualities of standard 25M with advantages of correct fluxing. Pre-coating assures the right amount of flux and speeds up welding. Flux adheres tightly to rod and does not spall off ahead of flame. Not affected by exposure to weather.

No. 31T bronze rod; for building-up wear-resisting surfaces subject to heavy loading, especially where elevated temperatures are encountered. Rod is harder than No. 25M but less ductile. It is preferable to No. 25M for motion parts, such as pistons, piston rods, guides, slides valves and similar parts.

OXYCUTTEND (Arc-oxygen cutting rods)—Arcos Corp., Philadelphia 43, Pa.

Coated tubular rod for cutting metals by the Oxyarc process. Cuts all metals using electric arc and stream of oxygen to achieve cutting.

P

PAGE (Wire)—Page Steel & Wire Div., American Chain & Cable Co., Inc., Monessen, Pa.

Low and high-carbon steel wire; also Ingot iron wire and stainless steel wire, furnished in various strengths and hardness numbers. Also same analyses in shaped wire for special purposes.

PAINTGRIP (Bonderized cold-rolled steel)—Armco Steel Corp., Middletown, O.

Iron or steel sheets or coils mill-treated with an electrolytic "flash" of zinc and then bonderized. Will draw, form, weld and solder readily. Eliminates bonderizing after fabrication. For housings, trim guards, etc.

PAISLEY (Adhesives) — Paisley Products Inc., Chicago 16, Ill.

Wide variety of adhesives including glues, pastes, resins, cements, etc.

PALINEY (Palladium-platinum-silver-copper-nickel alloy)—The J. M. Ney Co., Hartford, Conn.

No. 6; in wire, sheets, coiled strips, and plates for stamping, turning, boring, welding and soldering. Mechanical properties in heat-treated state: Ts, 170,000 psi; ys, 127,000; elong, 15 per cent; bhn, 270; sp gr, 10.9; nonmagnetic; abrasion resistance, medium. Used for pivots, small bearings, springs, electrical contacts etc.

No. 7; similar to No. 6 in analysis with the addition of gold; available also in the same form. In heat-treated state: Ts, 180,000 psi; ys, 148,000; elong 9 per cent; impact resistance, high; bhn, 280; sp gr, 11.9; nonmagnetic; weldability, good. For same uses as foregoing.

PAL-WELD (Solder and brazing compound)—Pal-Weld Mfg. Co., Seattle 4.

Also tinning compound. Furnished in bars and in powder form. Used on all metals except aluminum. For tinning bearings and welded seams.

PAMUDO (Plywood)—Pacific Mutual Door Co., Plywood Div., Tacoma 1, Wash.

Douglas fir plywood, furnished in stock sheet sizes and sizes to specifications. Has high chemical resistance, high impact resistance and high tensile strength. (U. S. Commercial Standards CS-45-45). For various industrial applications and uses in conjunction with metal parts.

PANELYTE (Laminated plastics)—Panelyte Division, St. Regis Paper Co., New York.

Laminated resinous thermosetting plastics in sheets, rods, tubes, structural forms and molded shapes supplied in fabric, paper, wood or asbestos base grades; parts fabricated or semifabricated to print. Various grades characterized by high strength, light weight, good electrical properties, excellent heat resistance, and freedom from odor. Unaffected by solvents, dilute acids and alkalies. Outstanding machinability, punchability and dimensional stability. Used in aircraft for propellers and propeller parts, air deflectors for engines, skin, fairings, intercompartment doors and for high "EI" molded flooring. Also for radio and other electrical insulation applications, gears, pinions and nonstressed or semistressed structural parts, and in refrigeration for trim and structural parts.

PAR (Alloy steel sand castings)—Crucible Steel Casting Co., Cleveland.

No. 2; C 0.25, Si 0.45, Mn 0.65, Ni 2.75, Cr 1.75, Mo 0.3, P 0.05; sand castings. In heat-treated state: Ts, 100,000 psi; ys, 75,000 psi; elong, 20 per cent; impact resistance, low; bhn, 230; magnetic; abrasion resistance, high; can be heat-treated for good wear resistance.

No. 6; C 0.2 max, Si 0.85, Mn 0.7, Cr 25, Ni 12; sand castings. In heat-treated state: Ts, 80,000 psi; ys, 42,000 psi; elong, 32 per cent; impact resistance, high; bhn, 165; sp gr, 7.5; nonmagnetic. Resists corrosion caused by sulphur dioxide; heat-resistant to 2000 F; abrasion resistance, low. Used for furnace parts and machine parts where corrosion resistance is desired.

No. 7; C 0.3, Si 0.85, Mn 0.7, Ni 35, Cr 15; sand castings. In untreated state: Ts, 73,000 psi; ys, 41,000 psi; elong, 7 per cent; impact resistance, low; bhn, 170; sp gr, 7.8; nonmagnetic; corrosion resistant; good for hydrochloric acid solution; heat-resistant to 2000 F; abrasion resistance, low. For heat-treating furnace parts, carburizing boxes, etc.

PARAPLEX (Plastics resins)—Resinous Products & Chemical Co., Philadelphia 5.

Furnished in liquid form for casting and laminating; abrasion resistance, high; has excellent resistance against acids, alkalies, solvents; is transparent; machinability, good.

PAR-EXC (Alloy tool steel)—Vanadium Alloy Steel Co., Anchor Drawn Steel Co., Colonial Steel Div., Latrobe, Pa.

C 0.50, Si 0.28, Mn 0.20, W 2.00, Cr 1.65 and V 0.25. Furnished in rough bars or billets, finished rods or bars, wire, sheet, plate, forgings and drill rods; for machining, hot and cold working, stamping, drawing and brazing. In heat-treated state: Hardness, rockwell C, 58 max; magnetic; weldability, fair; max cont serv temp, 600-800 F; abrasion resistance, medium. For wearing parts requiring a hard surface and a very high-strength core.

PARIAN (Plastics)—American Hard Rubber Co., New York 13.

Furnished in form of sheet and rods and tubes. Abrasion resistance, low; is resistant to almost all alkalis, acids, solvents at low temperatures; max cont serv temp, 105 F; is slow burning; flexibility, high; dielectric str, 500-700 volts per mil inst; ts, 1800-3000 psi; flexural str, 15-1700 psi; elongation, 50-600%; moisture absorption, 0.01%; produced in wide range of colors; is shatterproof; sp gr, 0.93; produced translucent and opaque; machinability, good; hardness, Rockwell R 25-R 35.

PARNAL (Plastics)—American Hard Rubber Co., New York 13.

Furnished in the form of sheet, rods and tubes. Abrasion resistance, low; slightly attacked by dilute acids and alkalis, is soluble in esters and ketones; max cont serv temp, 185 F; is slow burning; flexibility, high; dielectric str, 250-365 volts per mil inst; ts, 1500-8200 psi; flexural str, 2000-14,000 psi; elongation, 7-80%; moisture absorption, 2-6%; produced in any color; sp gr, 1.27-1.37; produced transparent, translucent and opaque; machinability, good; hardness, Rockwell R 40-R 125. Is a tough, high-impact, flexible plastic.

PARSAN (Polystyrene plastic)—American Hard Rubber Co., New York 13.

A thermoplastic produced in the form of sheet, rods and tubes. Abrasion resistance, medium; is resistant to alkalis and weak acids; max cont serv temp, 200 F; flexural str, 4800-19,000 psi; dielectric str, 500-700 volts per mil. inst.; ts, 3000-8500 psi; impact str (Izod), 0.25-0.6 ft-lb; produced in any color; moisture absorption, 0.04%; sp gr, 1.06; produced transparent, translucent and opaque; machinability, fair; hardness, Rockwell M55-M95. This material features excellent electrical characteristics plus dimentional stability.

PEARL CITY (Plywood)—Pearl City Plywood Co. Inc., Jamestown, N. Y.

Plywood and veneers for cold-press gluing, furnished in sheet form. Nonflammable; flexibility, as required; moisture absorption, low; produced in all native hardwoods and imported woods; machinability, good. For treads, etc.

PEERLESS (Fish paper insulation) — National Vulcanized Fibre Co., Wilmington, Del.

Converted cotton cellulose, chemically pure, fish paper insulation; furnished in sheets and rolls; high dielectric strength combined with toughness, springiness and good bending properties. Used extensively for generator and motor insulation applications.

PENACOLITE (Adhesives) Chemical Division, Koppers Company, Inc., Koppers Building, Pittsburgh 19, Pa.

G-1131: Resorcinol resin adhesive in two parts, capable of curing at room temperatures, providing durable, water-proof, fungus-proof bonds. Part A is a resin solution, part B a powdered setting agent. Recommended for bonding all cellulosic materials, many thermoplastic and thermosetting plastics, as well as some synthetic rubbers. Can be used with pressures as low as 25 psi. Recommended for use in joining wood where strength and proof against water, weathering, dampness and fungi are required. For bonding oak, G-1124 is recommended.

G-1133: Resorcinol resin adhesive in two parts, capable of curing at temperatures slightly above room temperatures to provide durable, water-proof bonds. Recommended for bonding wood where long open assembly time is required in order to build up the structure before the glue line has cured. Part A consists of a liquid resin, part B of a powdered setting agent. Recommended for use where strength and proof against water, weathering, dampness and fungi are required.

G-1124: Resorcinol resin adhesive in two parts, capable of curing at room temperatures. Part A consists of a resin solution containing reinforcing filler, part B the liquid formaldehyde setting agent. Recommended for bonding all cellulosic materials, and particularly for oak wood. Can be used with pressures as low as 25 psi. Recommended for use where strength and proof against water, weathering, dampness and fungi are required.

G-1215: Resorcinol resin adhesive in two parts modified with phenol to provide a somewhat lower cost adhesive which cures at room temperatures in a somewhat longer time than does G-1131. This adhesive can be used where longer clamping time can be tolerated in order to obtain a lower cost glue line. Otherwise it is recommended for the same uses as G-1131 and provides an equal bond where strength and proof against water, weathering, dampness and fungi are required.

PENN (Bronze welding rod)—Titan Metal Mfg. Co., Bellefonte, Pa.

Alloy W-16: Average tensile strength of V-weld, 52-57,000 psi; hardness of weld, 57-60 Rockwell B; melting point, 1628 F; shear str, 62,800 psi; low fuming; double deoxidation, good tinning, excellent flow.

PENN (Fiber)—Penn Fibre & Specialty Co., Philadelphia 34.

"B" Board; pulp board, furnished in sheets and strips, for stamping and forming. Abrasion resistance, low; max cont. serv. temp, 200 F; flexibility, high; opaque. For washers, gaskets, stampings for electrical parts, etc.

Vulcanized fiber; paper base material, furnished in sheet and rods or tubes, for machining or stamping into parts. Abrasion resistance, low; resists corrosion caused by oils and greases; flexibility, low, and high when treated with glycerine; ts, 6500-8500 psi; comp str, 20-35,000 psi; nonflammable; available in red, gray, white and black olive; shatterproof; sp gr, 1.36-1.4; corrosion-resistant. For insulation, special gaskets, washers, special parts, dust-guards, pulleys and gears, etc.

PENNVERNON (Double-strength window glass) —Pittsburgh Plate Glass Co., Pittsburgh 19.

Generally chemical resistant; nonflammable; flexibility, low; ts, 6500 psi; moisture absorption, low; sp gr at 70 F, 2.52; transparent. For use where unusual strength is required.

PERBUNAN (Nitrile rubber)—Enjay Co. Inc., New York 19.

Furnished in bales; abrasion resistance, high; is especially resistant to petroleum hydrocarbons, fats, oils and alcohols; max cont serv temp, 300 F; flexibility, high; dielectric strength (volts per mil. inst.), 380; ts, 100-4000 psi; elong, 100-800%; compression set, 3.5% min.; moisture absorption, low; produced in any color desired; is shatterproof; sp gr, 0.97; is opaque; hardness, 10-100 Shore Durometer A. Used for revolving shafts and bearing seals, flexible hose, vibration damping units, rolls, casters, flexible couplings, packings, gaskets, boots, mountings, diaphragms, milking machine inflations etc.

PERDURO (Malleable iron castings)—The Jeffrey Mfg. Co., Columbus 16, O.

C 1.60-1.90, combined C 0.40-0.60, Mn 0.50-0.70, Si 0.90-1.10. Heat treated; ts, 80-90,000 psi; ys, 60-70,000 psi; elong in 2 in., 8 to 6%; bhn, 179-207. For chain links, sprockets, etc.

PERMACLAD (Stainless clad steel)—Alan Wood Steel Co., Conshohocken, Pa.

Type 304 stainless with 1010 analysis backing steel. Both the stainless and backing steel can be changed to meet individual requirements. Furnished in sheet and plate; has good weldability; has same corrosion resistance as type 304 stainless.

PERMANITE (Furane resin thermosetting plastics)—Maurice A. Knight Co., Akron 9, O.

Furane resin; thermosetting; furnished in sheet or laminated form, for compression molding and casting. Abrasion resistance, medium; resistance to acid and alkalies, excellent; max cont serv temp, 350 F; ts, 1000 psi; comp str, 50,000 psi; available in black only; moisture absorption, low; sp gr, 90 lb per cu ft; opaque. Used as acid and alkali-proof cement and for structural parts exposed to acids and alkalies. Can also be cast into various shapes in rubber molds, cellulose acetate molds and steel molds.

PERMITE (Aluminum-base alloy castings)—Aluminum Industries Inc., Cincinnati.

Following grades are available as sand castings, permanent-mold castings, and high pressure die castings.

No. 1002; Cu 10, Fe 1.5, Mg 0.4, balance Al. For pistons for automotive, pump and refrigeration service.

No. 1010; Cu 4, Si 1, balance Al. For machine parts to resist shock. Heat treatment is to soak at critical and quench in water, and reheat at 350 F to desired properties.

No. 1019; furnished in sand and permanent-mold castings. Si 5, Cu 1.25, Mg 0.5, balance Al; heat treatment, quenching in water. Suitable for highly-stressed parts including airplane engine parts.

No. 2011; Si 5; balance Al. For parts subject to atmospheric corrosion.

No. 2021; Mg 4, balance Al. For parts subject to salt water corrosion.

PERMOLD (Aluminum castings)—The Permold Co., Medina, O.

Sand-cast and permanent-mold aluminum castings of standard analyses to specification.

PETERSON (Steel)—Peterson Steels Inc., New York 17.

An SAE 52100 steel in following analysis: C 0.95-1.10, Mn 0.25-0.45, Si 0.20-0.35, P 0.25 max, S 0.25 max, Cr 1.30-1.60, Ni 0.35 max, Cu 0.25 max, Mo 0.08 max; furnished in rough bars or billets, finished rods, forgings, bars and tubing; abrasion resistance, high. For ball and roller bearings, spindles, thrust collars, hardened sleeves, clutch liners and faces, etc.

PHEMALOID (Plywood)—Haskelite Mfg. Corp., Grand Rapids 2, Mich.

Compound lumber; phenolic resin bonded; furnished in sheets; waterproof; resistant to fungus, bacterial decay, and diverse climatic conditions; bendable to desired forms. Used for truck, bus and train floors, boat

hulls and decks, etc. Supplied in flat stock only, in sizes 48 x 96 in. and 72 x 96 in.

PHENOLITE (Laminated plastics) — National Vulcanized Fibre Co., Wilmington, Del.

Furnished with base of paper, asbestos paper, cotton, asbestos and glass cloths in sheets, rods, tubes and fabricated shapes; also laminated with rubber sheet; high dielectric and mechanical strengths; low moisture absorption; heat-resistant; nonfusible; resistant to acids, solvents and oils; high resistance to wear and impact; machinable. Used in electrical, mechanical and chemical applications for silent gears, bearings, bushings, washers, valve disks and terminal strips, etc.

PHENOPREG (Thermosetting plastic sheet) — Fabricon Products Inc., River Rouge 18, Mich.

Melamine formaldehyde and phenol formaldehyde thermosetting plastic sheet. Abrasion resistance, high; flexural str (ASTM D 790), 20,000 psi; ts, 10,000 psi; comp str, 25-63,000 psi; produced in variety of colors and patterns; moisture absorption, 2.5% in 24 hours; sp gr, 1.3-1.8; produced translucent and opaque; used for gear blanks.

PHILO (Ferro alloys)—Ohio Ferro Alloys Corp., Canton, Ohio.

Ferro alloys for deoxidizing agents and for alloying in the production of iron and steel.

PHOS-COPPER (Brazing alloy)—Westinghouse Electric Corp., East Pittsburgh, Pa.

Available in rod or strip containing 5-7% phosphorus and balance copper. Alloy is more economical than silver brazing alloys and produces good joints on copper or nickel-base alloys.

PHOSNIC (Bronze)—Chase Brass & Copper Co., Waterbury 91, Conn.

Cu 98.15, Ni 1.10, P 0.25. Furnished in wire. Heat treated; ts, 120,000 psi; ys, 105,000 psi; elong in 2 in., 3%; hardness, Rockwell B, 95; nonmagnetic; resists industrial atmospheres, sea air and water, many saline solutions and dilute acids. For bolts, screws, rivets, springs, etc.

PICCOLASTIC (Polystyrene thermoplastic plastics)—Harwick Standard Chemical Co., Akron, O.

Furnished in solid form for casting and hot melting, in clear colors. Sp gr, 1.02; transparent.

PINCO (Porcelain) — The Porcelain Insulator Corp., Lima, N. Y.

Wet plastic process high-tension porcelain insulators and clamps and fittings for use with same.

PIONEER (Nickel-chrome alloy steel)—Pioneer Alloy Products Co., Cleveland 12.

Furnished as sand castings to specifications; no heat treatment required; ts, 74,000 psi; ys, 36,500 psi; elong in 2 in., 42%; sp gr, 7.833; nonmagnetic; resists corrosion caused by sulphuric, nitric, phosphoric and other acids; abrasion resistance, high.

PITALOY (Manganese-molybdenum steel)—Pittsburgh Steel Foundry Co., Glassport, Pa.

Manganese-molybdenum alloy: Ts, 85,000 psi; ys, 55,000 psi; elong, 22%; reduction of area, 40%; machinability, good. Used for locomotive frames, crossheads, coupling boxes and spindles, driving wheel centers, gears, etc.

PITT (Babbitt)—Pitt Metals Co., Pittsburgh 24.

Furnished in bars and pigs, for all bearing work, heavy-duty, high-speed, rolling mill, etc.

PITTSBURGH (Plate glass) — Pittsburgh Plate Glass Co., Pittsburgh 19.

Plate glass generally chemical resistant; nonflammable; low flexibility; ts, 6500 psi; comp str 36,000 psi; moisture absorption, low; available in water white, blue, flesh-tinted, blue-green; sp gr at 70 F, 2.52. For food processing equipment, etc.

PITTSBURGH (Steels) — Pittsburgh Steel Co., Pittsburgh 30.

Carbon and alloy steels, carbon and alloy wire and rods, and carbon, alloy and stainless seamless tubes to standard specifications such as AISI and SAE Analyses.

PLANET (Steels and aluminums)—A. R. Purdy Co. Inc., Lyndhurst, N. J.

Carbon and alloy types of steel in the form of rough bars or billets, finished rods or bars, straight and coiled strips, tubing, wire and sheets. Also all types of aluminum sheets.

PLASKON (Thermosetting plastics) — Plaskon Division, Libbey-Owens-Ford Glass Co., Toledo.

Urea-formaldehyde, thermosetting material; furnished in powder and granules for compression and transfer molding; abrasion resistance, high; resists corrosion caused by weak acids and alkalies; heat resistant to 170 F; flexural str, 10-16,000 psi (ASTM D 650-42T); dielectric str, 300-400 volts per mil; ts, 8000-13,000 psi; comp str, 25-35,-000; impact str, 0.24-0.35 ft lb (Izod); moisture absorption, medium; available in colors; sp gr, 1.50±0.02; translucent. Used for housings, trim, knobs, dials, etc.

Melamine-formaldehyde, thermosetting material; furnished in powder and granules for compression and transfer molding; abrasion resistance, high; resists corrosion caused by weak acids and alkalies; heat resistant to 210 F; dielectric str, 300-400 volts per mil; ts, 8000-13,000 psi; comp str 25-35,000; available in colors, sp gr, 1.50±0.02; translucent. For handles, dials, gage plates etc.

PLASTACELE (Cellulose acetate plastic)—E. I. du Pont de Nemours & Co., Inc., Arlington, N. J.

Cellulose acetate base, thermoplastic; furnished in powder, sheets, rods and tubes for machining and molding. Swaged and machined articles are affected only slightly by weak acids and alkalies; decomposed by strong acids and alkalies; soluble in acetone, acetates, etc. Max cont serv temp, 165-190 F at 66 psi; flexural str, 6-9000 psi (ASTM D 650-42T); dielectric str, 275-350 volts per mil; ts 2800-8000 psi; comp str, 4-7000 psi; impact str, 1.0-4.0 ft-lb (Izod); available in colors; moisture absorption, medium; sp gr, 1.27-1.37; transparent, translucent and opaque. Used for oil gages.

PLASTIKFLEX (Flexible tubing, thermoplastic)—R. D. Werner Co. Inc., New York.

Flexible tubing, thermoplastic; to be extruded. Used for conduits, insulation, hose, fuel lines, hospital equipment, sleeving, spacers, stirrup pumps, gaskets, gages (square tubing for dehydration), etc.

PLAST-IRON (Powder metal) — Plastic Metals Div., The National Radiator Co., Johnstown, Pa.

99% iron. After pressing in die, material is sintered in protective atmosphere at 1800 to 2200 F for from 30 to 90 minutes. Apparent density of powder, 2.2-2.7 grams per cu cm; weldability, good; abrasion resistance, high. For permanent magnets, iron cores, and other powder metal parts.

PLAST-MANGANESE (Powder metal)—Plastic Metals Div., The National Radiator Co., Johnstown, Pa.

99% manganese. Apparent density, 3.5 grams per cu cm; nonmagnetic. For strong, hard ferrous parts made by powder metallurgy.

PLAST-NICKEL (Powder metal) — Plastic Metals Div., The National Radiator Co., Johnstown, Pa.

99% nickel powder, 6 to 325 mesh; furnished in blended powders and separate unblended powders. For alloying with iron powder and for compacted and sintered nickel powder parts. For electrical contacts and other powder metallurgy parts.

PLASTONE (Thermosetting plastic)—National Plastics Inc., Knoxville, Tenn.

Phenol-formaldehyde thermosetting plastic, furnished in the form of powder. Compression and transfer molding. Abrasion resistance, high; flexural str, 9000-11,000 psi (ASTM D 650); impact str (Izod), 0.25-0.30; furnished in dark colors; moisture absorption, 0.3%; sp gr, 1.39; is opaque; machinability, good.

PLAST-SILICON (Powder metal)—Plastic Metals Div., The National Radiator Co., Johnstown, Pa.

Si 97, Fe 1. Powder metal for alloying. Apparent density, 0.9 to 1.3 grams per cu cm; nonmagnetic. For parts made by powder metallurgy requiring special corrosion resistance or electrical properties.

PLAST-SPONGE (Powder metal)—Plastics Metals Div., The National Radiator Co., Johnstown, Pa.

Fe 97, C 0.9, Mn 0.3, P 0.1, Si 0.2. Powder metal. After pressing in die, sinter in protective atmosphere at 1800-2200 F; for from 15 to 90 minutes. Apparent density of powder, 2.2-2.7 grams per cu cm; magnetic; weldability, fair; abrasion resistance, high. For oiless bearings, iron cores and other parts made by powder metallurgy.

PLAST-STEEL (Powder metal)—Plastic Metals Div., The National Radiator Co., Johnstown, Pa.

Steel powder, 100-325 mesh; in blended powders and separate unblended powders prepared to customers' specifications; for powder metal parts requiring high physical properties such as gears, cams, pawls, etc.

PLATINUM CLAD (Platinum-clad metals)—Baker & Co. Inc., Newark 5, N. J.

Pure platinum welded to various base metals, in sheet, tubing and wire. Resists corrosion caused by usual acids; medium abrasion resistance; good weldability; ts, ductility, etc., are dependent upon properties of base metals. Used for tubing exposed to acids and for vessels subject to same.

PLAX (Plastics)—Plax Corp., Hartford 1, Conn.

Polystyrene; thermoplastic: Furnished in rods, sheets, tubes, films, fibers and blown ware. Ts, 5500-7000 psi, flex str, 8000-19,000 psi; comp str 11,500-15,200 psi; Rockwell hardness, M 80-M 95; elong, 1.5-3.5%; softening point, 220-240 F; sp gr, 1.05-1.07; water absorption (24 hours), 0.04-0.06; machinability, fair to good. Tubing is used for high-frequency electrical insulations, chemical applications, etc.

Cellulose acetate: Furnished in rods, sheets, tubes, films and fibers. Ts, 3000-10,000 psi; flex str, 1500-12,000 psi; comp str, 5000-30,000 psi; Rockwell hardness, M 25-M 80; elong, 7-80%; softening point, 145-260 F; sp gr, 1.27-1.37; water absorption (24 hours), 2-6%; machinability, good.

Cellulose acetate butyrate: Furnished in rods, sheets, tubes, films and fibers. Ts, 2500-6700 psi; flex str, 2000-13,000 psi; comp str, 7500-22,000 psi; Rockwell hardness, M 25-M 69; elong, 35-95%; softening point, 140-250 F; sp gr, 1.10-1.24; water absorption (24 hours), 1.6-2.1%; machinability, good. Sheet is used for electrical and telephone insulation; rod is used for knobs, handles, tool handles, etc.

Ethyl cellulose: Furnished in rods, sheets, tubes, films and fibers. Ts, 2000-9000 psi; flex str, 3000-12,000 psi; comp str, 8000-20,000 psi; Rockwell hardness, M 25-M 65; elong, 5-100%; softening point, 200-260 F; sp gr, 1.07-1.18; water absorption (24 hours), 1.0-2.5%; machinability, good.

Polyethylene: Furnished in rods, sheets, tubes, films and fibers. Ts, 1700-1900 psi; flex str, 1500-1700 psi; Rockwell hardness, R 25-R 35; elong, 50-600%; softening point, 219-239 F; sp gr, 0.92; water absorption (24 hours), 0.005-0.01%; machinability, fair to good.

Methacrylate: Furnished in rods, tubes, sheets and fibers. Ts, 4000-7000 psi; flex str,10,000-17,000 psi; comp str, 10,000-12,-000 psi; Rockwell hardness, M 40-M 70; elong, 1.5%; softening point, 150-230 F; sp gr, 1.16-1.20; water absorption (24 hours), 0.4-0.5%; machinability, good.

PLEXENE (Styrene-base plastics) — Rohm & Haas Co., Philadelphia 5.

Modified styrene copolymer, thermoplastic; furnished in powders for injection molding. Abrasion resistance, medium; chemical resistance, good; max cont serv temp 194 F; flex str, 16,000 psi (ASTM D 650-42T) dielectric str, 350±25 volts per mil (short time test); ts, 10,000 psi max; comp str, 15,000 psi; impact str, unnotched 4-5 ft-lb (Charpy); notched, 1.02 ft-lb (Izod); pro-

duced in colors, natural color amber; moisture absorption, low; sp gr, 1.08; transparent, translucent and opaque; machinability, good. For pen and pencil barrels, radio cabinets, etc.

PLEXIGLAS (Acrylic-base plastics)—Rohm & Haas Co., Philadelphia 5.

Methyl-methacrylate, thermoplastic; furnished in sheets, granules and powders for injection and compression molding and forming. Abrasion resistance, medium; chemical resistance, good; max cont serv temp, type "I-A" sheet, 140 F; type "II" sheet, 180 F; molding powder, up to 185 F; flex str, 13,000+ psi, (ASTM D 650-42T); dielectric str, 400 volts per mil (0.125-in. thick material); ts, 6800 psi min; comp str, 13-15,000 psi; impact str, unnotched, 3-4 ft-lb (Charpy); notched 0.35 ft-lb (Izod); produced in colors; moisture absorption, low; sp gr, 1.18; transparent and translucent; machinability, good. For guards, pump parts, dials, housings, etc.

PLEXIMENT (Plastics cement)—Plastic Parts & Sales, St. Louis 10, Mo.

Furnished in liquid form for cementing acrylic resin plastics parts. Furnished clear only.

PLUSWOOD (Resin-impregnated wood) — Pluswood Inc., Oshkosh, Wis.

Resin-impregnated plywood. Furnished in any desired thickness, in large or small sheets, in natural dark deep brown color. Has wood grain with high gloss finish; high density; lightweight; and is resistant to exposure. It can be sawed, drilled, turned, threaded, milled and tapped; nonflammable; highly resistant to decay, acids, alcoholic mixtures and other organic liquids. Sp gr, 1.3-1.4; ts (parallel laminated in fiber direction), 32-40,000 psi; comp str, 20-28,000 psi; impact (Izod), 6-8 ft-lb per in. of notch. For use as exhaust and blower fan blades, and in boat-building, aircraft and automotive industries.

PLYMETL (Sheet-metal bonded plywood)—Haskelite Mfg. Corp., Grand Rapids 2, Mich.

Resin-bonded plywood, sheet metal bonded to one or both faces; has stiffness, rigidity, light weight; metal on both faces insuring freedom from warpage. Types available for different purposes are galvannealed steel, stainless steel, aluminum, copper, chrome zinc, chrome steel, porcelain, etc. Used for applications in the automotive and railroad fields.

PLYMOLD (Plywood) — Haskelite Mfg. Corp., Grand Rapids 2, Mich.

Resin-bonded plywood, molded in simple or compounded curvatures.

PLYOPHEN (Plastic resins and varnishes) — Reichhold Chemicals Inc., Detroit 20.

Phenolic aldehyde, thermosetting. Furnished as liquid resins or varnishes; soluble in alcohol. For laminating, impregnating bonding and casting; abrasion resistance, high; resists corrosion caused by nearly all chemicals except strong oxidizing acids and strong alkalies. Heat resistant to 275 F; flexibility, medium; dielectric str, 300-900 depending on the requirement; ts, 10-36,000 psi; comp str, 35,000 psi; moisture absorption, low; available in natural or black; shatterproof. For use where good mechanical properties are needed along with good dielectric strength, and corrosion resistance. One type used for bonding of wood under heat and pressure for plywood. Others are laminating varnishes used with paper, canvas, fiber glass, etc., to produce phenolic laminates, properties of which depend on the type of paper, etc., used. Tensile strength of 26,000 psi can be obtained for paper laminates; while with fiber glass, tensile strengths of 80,000 have been produced.

PLY-TECH (Plywood) — Technical Ply-Woods, Chicago 1.

Thermosetting; furnished in sheet form for machining into parts; abrasion resistance, good; resists corrosion, repels termites; heat resistance, good; bonded at 350 F; flexibility, medium to low depending on thickness; tensile and compressive strengths, good to excellent depending on thickness; moisture resistance depends on treatment; machinability, excellent.

POLAROID (Light-polarizing glass and plastic)—Polaroid Corp., Cambridge, Mass.

Principal property is 99.5% polarization of transmitted light uniformly over large area. Used for camera filters, polarizing attachments for microscopes, polarimeters, and other scientific instruments. Also for polariscopes to determine strain.

POLYCO (Nylon)—The Polymer Corp., Reading, Pa.

Type FM-10001: Furnished in rods, strips, and castings. Ts, 11,300 psi; comp str, 24,000 psi; flexural str, 21,250 psi; hardness, Rockwell M 89; heat distortion temperature (at fiber stress of 264 psi), 182 F; Izod impact str, 0.65 ft-lb/in. of notch; sp gr, 1.14; power factor (10^6 cycles), 0.04; dielectric constant (10^6 cycles), 3.4. Substantially inert to virtually all organic acids; carbon bisulfide, halogenated hydrocarbons, carbon tetrachloride, trichlorethylene, alkalies, soaps, gasoline, benzene, aldehydes, ketones and alcohols. Rods available from 0.100 to 2¾ in. diam. by 8-ft lengths. Strip is supplied in coil form in widths to 2 in. in all gages from 0.010 to 0.065-in. Material is used for bearings, gears, valve seats, washers, insulators, etc.

POLYFLEX (Polystyrene plastics)—Plax Corp., Hartford 1, Conn.

Thermoplastic; furnished in laminated sheets, for molding and machining into parts; abrasion resistance, medium; resists corrosion caused by acids, alkalies and alcohol; max cont serv temp, 170 F; flexibility, medium; dielectric str, 500-3500 volts per mil; ts, 7000-10,000 psi; moisture absorption, low; shatterproof; sp gr, 1,052; transparent; machinability, good. For electronic parts, covers, etc.

POLYTHENE (Polyethylene plastics)—E. I. du Pont de Nemours & Co. Inc., Plastic Dept., Arlington, N. J.

Available in sheet, tube, granules and plates. Fabricated into machine parts by all types of molding, casting and extruding. Abrasion resistance, low; is chemically resistant to water, acids, alkalies, oxygenated solvents; not resistant to chlorinated solvents, aromatic and aliphatic hydrocarbons; max cont serv temp, 140 F; dielectric str, 460 volts per mil inst; ts, 1500 psi; available in natural (waxy translucent white) and limited special colors; moisture absorption, 0.01; sp gr, 0.92; is transparent in very thin layers; other, translucent; hardness (Durometer ASTM D676-44T), D45; useful for tubing, pipes, fittings, tank lining, and valve diaphragms.

POMPTON (Carbon tool steel)—Allegheny Ludlum Steel Corp., Brackenridge, Pa.

High quality carbon tool steel available from warehouse stocks in the general-purpose range C 0.95-1.05. Suitable for arbors, bushings, lathe centers and other machine parts where a water-hardening tool steel is desired.

POWDIRON (Porous iron bearing alloys)—Bound Brook Oil-Less Bearing Co., Bound Brook, N. J.

Porous iron bearing alloys available in three grades. All have high compressive strength.

61P: Contains no tin and only 10% copper and is impregnated with 25% of oil by volume. Stronger than other materials furnished by company, and recommended for heavy-duty, slower motion requirement where tensile strength is determining factor, as in aviation and ordnance industries. Ts, 30,000 psi; comp str, 140,000 psi.

55P: Contains no tin and only 5% copper. Used to conserve copper and tin. Ts, 12,000 psi; sp gr 5.5; comp str, 140,000 psi. Oil by volume, 32%. Subject to corrosion under certain conditions, but due to protective film of oil will show less tendency to corrode than steel shaft.

59-I: Straight-iron material impregnated with 25% oil by volume. Recommended for parts other than bearings which may or many not be sized to close dimensions. Smooth mirror finished surface reduces friction. Ts, 12,000 psi; comp str, 130,000 psi.

POWER NICKEL GENUINE (Babbitt) — Magnolia Metal Co., Elizabeth, N. J.

Approximately 85% tin, nickel treated, free of lead; bhn, 27. Designed to withstand heavy sustained loads and high heat conditions. It is alloyed for strength and hardness, and will not squeeze out under heavy pressures.

POWMETCO (Powder metals)—Powmetco, Inc., Byram, Conn.

108; furnished as pressed and sintered parts to specifications. Coercive force, Hc, in oersted, 180; residual induction, Br, in gauss, 8,000; hardness, Rockwell C, 50; sp gr, 7.78. Permanent magnet, low cost, replaces 17% cobalt steel. For parts in thermostats, meters and instruments.

101; pure copper powder metal parts furnished pressed and sintered to specifications. With density of 0.299 lb per cu in.; ts, 25,000 psi; ys, 18,000 psi; hardness, Rockwell H, 45; sp gr, 8.2 with density of 0.322 lb per cu in., ts, 30,000 psi; ys, 22,000 psi; hardness, Rockwell H, 55; sp gr, 8.9. Latter material has 96% electrical conductivity. For shading coils and other electrical parts.

103; pure iron powder parts furnished pressed and sintered to specifications. Ts, 35,000 psi; ys, 20,000 psi; hardness, Rockwell H, 50; sp gr, 6.90; magnetic. For low cost machine parts.

104; contains 0.80 Cu, balance Fe plus 1% max imp. Furnished in pressed and sintered parts to specifications. Ts, 50,000 psi; ys, 35,000 psi; hardness, Rockwell C, 18; sp gr, 6.85. For medium-strength low-cost machine parts such as cams, pawls, low-load gears, etc.

105; furnished in pressed and sintered parts to specifications. Contains Fe 80, Cu 20. Ts, 60,000 psi; ys, 45,000 psi; hardness, Rockwell H, 75; sp gr 7.00. Provides good strength at low cost.

102; furnished in pressed and sintered parts to specifications. Ts, 30,000 psi; ys, 20,000 psi; bhn, 51; sp gr, 7.72. For low-load gears, cams, pawls, etc.

106; for oil impregnated bearings to specification. Has 20% porosity; ts, 15,000 psi; ys, 8,000 psi; hardness, Rockwell H, 25; sp gr, 6.8.

107; furnished in pressed and sintered parts to specifications. One hundred per cent Fe; ts, 40,000 psi; ys, 23,000 psi; hardness, Rockwell H, 60; sp gr 7.4. For electrical uses such as pole pieces.

109; supplied in pressed and sintered parts to specification. Sp gr, 7.86; coercive force, Hc, in oersted 250; residual induction Br, in gauss 10,500; hardness Rockwell C, 50. Permanent magnet; low cost; replaces 36% cobalt steel. Used in thermostat, meters, and various instruments.

PRECISION (Aluminum and zinc-base alloys)—Precision Castings Co. Inc., Syracuse, N. Y.

Type A-12; aluminum base alloy; Si 12, balance Al. Resists heat to 1000 F; ts, 33,000 psi; sp gr 2.66. For general aluminum die casting uses.

Type ZN-5, zinc base alloy; Al 4, Cu 1, Mg 0.04, balance zinc; ts, 42,000 psi; comp str, 85,000; sp gr, 6.71; bhn, 75. For general die casting uses—automotive, washing machines, electrical equipment, etc.

A-50; aluminum base alloy; Si 5, Al bal., furnished as castings. Resists corrosion caused by atmosphere, foods, etc.; abrasion resistance, medium; ts, 29,000 psi; ductility, medium. For use where corrosion resistance and ductility are needed.

A-94; aluminum base alloy, Si 8.5, Cu 3.5, Al bal. Ts, 38,000 psi; elong in 2 in., 2½%. Conforms to Federal Specification AXS-679, Rev. 3.

X-360: Aluminum-base die casting alloy; Si 10, Mg 0.5, bal Al. Is not heat-treatable. Ts, 35,000 psi; elong in 2 in., 3.5%. Al-218; Al; not heat-treatable. Ts, 45,000 psi; elong in 2 in., 5%. Alloy has excellent resistance to corrosion.

PRECISION (Tubing and wire)—Precision Tube Co., Philadelphia.

Seamless tubing in nickel, aluminum, copper and brass. For machining, cold working, drawing, brazing and plating. Hardnesses to specification. For vacuum tube parts, air restriction tubing temperature and pressure control apparatus and instrument pointers.

Precision metal shielded wire; copper, brass, aluminum or nickel, tubing around virtually any dielectric and inner conductor. For machining and cold working; weldability, good; max cont. serv. temp. depends on dielectric

strength. For electronic equipment, sound systems, shielding conductors in corrosive atmospheres, shielded wires, radio components.

PREG-TECH (Impregnated Wood) — Technical Ply-Woods, Chicago 1.

Thermosetting; furnished in sheet form for machining into parts; abrasion resistance, good; resists corrosion, repels termites; heat resistance good; bonded at 350 F; flexibility, medium to low depending on thickness; tensile and compressive strengths, good to excellent depending on thickness; moisture resistance, excellent; machinability, good.

PRESDWOOD (Wood-fiber panels) — Masonite Corp., Chicago.

Wood fiber board furnished in sheets ⅛, 3/16, ¼, 7/16-inch thick, max size 4 x 12 ft, for machining into parts. Abrasion resistance, medium; chemical resistance, good to fairly weak solutions; max cont serv temp, 300 F; flexibility, low; ts, 3200 psi; comp str, 16,500 psi; transverse str, 5900 psi; moisture absorption, low; available in natural brown, opaque, shatterproof; sp gr 1.02; machinability, good. For various industrial uses. This material is also available in "Tempered" and "S2S Tempered" grades.

PRESSUREDIE No. 2 (High alloy steel)—Braeburn Alloy Steel Corp., Braeburn, Pa.

High alloy steel containing C 0.35, Si 0.90, Cr 5.00, V 0.20, Mo 1.40, and W 1.10. Furnished in rough bars or billets, finished rods or bars, for machining. Recommended heat treatment, 1825 F air cool, draw 1050-1150 F. In heat-treated state: Ts, 250-000 psi; ys, 200,000 psi; bhn, 417,514. For extrusion dies, extrusion press rams and liners etc.

PROMAL (Malleable iron)—Link-Belt Co., Indianapolis 6.

Specially processed malleable iron having high yield and fatigue strengths; for resistance to mild corrosive attack can be furnished with copper content; can be hot-dip galvanized without embrittlement and can be used in ovens and furnaces up to 1100 F. Uses include conveyor and drive chain links, bearing caps, rocker arms, sheaves, levers and other parts subjected to severe service.

PROMET (Bronze bearing metals)—The American Crucible Products Co., Lorain, O.

Have good compr str, low coefficient of friction, good lubricating qualities. Ts, 18-80,-000 psi; ys, 11-40,000 psi; bhn, 30-150; elong in 2 in., 20-14%. For bearings and wearing parts, such as spur and worm gears, bushings, seals, thrust plates, connecting rods, etc.

PSF (Steels)—Pittsburgh Steel Foundry Corp., Glassport, Pa.

Steel castings up to the largest in carbon or alloy steels and Pitaloy. For railroad and marine industries; also for other types of machines.

PSI (Steels)—Peterson Steels Inc., New York 17.

No. 1; C 0.92-1.02, Mn 0.95-1.25, Si 0.50-0.70, P 0.025 max, Cr 0.90-1.15, S 0.025 max, Ni 0.35 max, Cu 0.25 max, Mo 0.08 max; furnished in rough bars or billets, finished rods or bars, forgings, and tubing, for machining. Abrasion resistance and tensile strength, high. For ball and roller bearings, bushings, thrust collars, spindles, hardened sleeves, clutch liners and faces, knives, etc.

No. 2; C 0.87-0.97, Mn 1.40-1.70, Si 0.60-0.80, p 0.025 max, S 0.025 max, Cr 1.40-1.70, Ni 0.35 max, Cu 0.25 max, Mo 0.08 max; furnished in ingots. Rods or bars, forgings and tubing, for machining. Abrasion resistance and tensile strength, high; good bearing qualities. For ball and roller bearings, bushings, spindles, collars, hardened sleeves, clutch liners and faces, etc.

PUREBON (Carbon graphite)—Pure Carbon Co., Inc., St. Marys, Pa.

Available in 23 different grades having following property ranges: Scleroscope hardness, 40-90; Rockwell hardness, 55-98; transverse str, 4500-13,000 psi; coef. of linear expansion, 1.2-12.1 x 10^{-6}; max safe oper temp, 375-800 F. Material is self-lubricating and nonsealing against metallic surfaces; is not corrosive; dimensionally stable; readily machined; readily molded; used for seal rings, bearings, piston and piston rings, pump vanes, gears and plates, high-temperature molds, stuffing box seals, etc. Can be copper-coated for soldering to metals; can be cemented or vulcanized to rubber; can be cemented to metal.

PURPLE STRAND (Wire rope)—Bethlehem Steel Co., Bethlehem, Pa.

Wire rope, improved plow steel grade.

PYRALIN (Cellulose nitrate plastic)—E. I. du Pont de Nemours & Co., Inc., Arlington, N. J.

Nitrocellulose base, thermoplastic; furnished in sheets, rods and tubes for machining into parts. Swaged, die-pressed and machined parts offer abrasion resistance, are unaffected by weak acids, but decomposed by strong acids; gradually decomposed by alkalies and soluble in alcohols and esters. Max cont serv temp, 170-185 F at 66 psi; flexural str, 6000-15,000 psi (ASTM D 650-42T); dielectric str, 250-500 volts per mil; ts, 3-8000 psi; comp str, 20-30,000 psi; impact str, 5-9 ft lb (Izod); available in colors; moisture absorption, low; sp gr, 1.33-1.6; transparent, translucent and opaque; good machinability. Used for handles, gage glasses, instrument covers, etc.

PYRAMID METAL (Antifriction metal)—Magnolia Metal Co., Elizabeth, N. J.

Lead-tin-antimony-arsenic alloy furnished in ingots. Ts, 17,850 psi; ys, 8875 psi; bhn, 25; abrasion resistance, medium. For applications where bearings must withstand heavy sustained pressures such as in marine reciprocating engines, water turbines, paper mill calender stocks, etc.

PYRASTEEL (Alloy steel castings) — Chicago Steel Foundry Co., Chicago 32.

Ni varies from 8% up, Cr from 8.26%; available as castings for heat-treating furnaces, screw conveyors, or any high-temperature service to 2200 F. Also available in following grades:

No. 14: Cr 6, Mo 5.

No. 18: Ni 25, Cr 16.

No. 20: Ni 35, Cr 18.

No. 2000: Cr 26-28, Ni 12-14.

All of these grades carry a high silicon content, varying from 1-2.5 per cent.

PYREX (Glasses)—Corning Glass Works, Corning, N. Y.

In general, glasses with coefficient of expansion ranging from 20 to 50 x 10^{-7} C. Blown, drawn, pressed products with wide range of chemical, physical, optical, electrical and mechanical properties.

PYTHON (Water-hardening steel) — Allegheny Ludlum Steel Corp., Brackenridge, Pa.

C 0.85, V 0.25. For chuck jaws, clutch pins and other parts requiring unusual wear and shock resistance. Water hardening.

R

RAILFACE (Welding rod)—American Manganese Steel Div. of American Brake Shoe Co., Chicago Heights, Ill.

C-Cr-Mo; For hard facing only; bhn, 325-350; high resistance to impact; for building up carbon steel frogs, crossings, and rail-ends.

RANDALL (Bronze)—Randall Graphite Bearings Inc., Chicago 6.

SAE No. 64 bronze or as specified; furnished as sand castings. Resists corrosion caused by moisture; resists heat to 700 F; high abrasion resistance; ts, 30,000 psi; medium ductility; good bearing properties; conductivity, good; bhn, untreated, 80. For use as bushings, graphite-inserted in the perforated or drilled hole, grooved, or reservoir type.

RANIER (Ferro alloys)—Ohio Ferro Alloys Corp., Canton, Ohio.

Ferro alloys for deoxidizing agents and for alloying in the production of iron and steel.

RAYDUCT (Butt-welded steel pipe)—Bethlehem Steel Co., Bethlehem, Pa.

High ductility; used for radiant heating installations.

RAZOSEAL (Felt gasketing)—Stratocote, Inc., Los Angeles 1.

A felt-base gasketing composition supplied in rolls and tapes; in the colors blue and gray; does not fatigue or harden with age.

REANITE (Plastics bonding resin) — United States Stoneware Co., Akron 9.

Resinous base, thermosetting material, furnished in liquid form, for bonding metals to metals or rubber and plastics to metals; abrasion resistance, medium; resists corrosion caused by acids and alkalies; heat-resistant to 300 F; flexibility, high; ts, 3000 psi; moisture absorption, low; shatterproof; available in black only; opaque.

RED ANCHOR (Drill rods)—Anchor Drawn Steel Co., Latrobe, Pa.

C 0.95-1.1; commercial carbon drill rods. Strength varies from 70,000 psi, annealed; to 225,000 psi fully hardened; reduction in area when annealed, as high as 50 per cent. For precision shafts for motors, spindles, anvils, tools, dies, etc.

RED-CUT SUPERIOR (High-speed steel) — Vanadium Alloys Steel Co., Anchor Drawn Steel Co., Colonial Steel Div., Latrobe, Pa.

C 0.50, 0.60 and 0.70, W 18, Cr 4.00, V 1.00, Si 0.25, and Mn 0.25. Furnished in rough bars or billets, finished rods or bars, wire, sheet, plate, forgings and drill rods; for machining, hot and cold working, stamping, drawing and brazing. In heat-treated state: Impact str, Charpy (unnotched), 30; hardness, rockwell C 67 max; sp gr, 8.67; magnetic; max cont serv temp 1200 F; abrasion resistance, high. For high temperature springs, etc.

REDHARD NF (Casting alloy)—Redhard Metals Inc., Glenside, Pa.

Co 45.2, Cr 32.2, W 18.1, C 2.4. For precision castings; no heat treatment required. Ts, 73,000 jsi; hardness, Rockwell C62-C63; machinability, poor; resists most acids, weather, etc.; abrasion resistance, high; heat resistant to 2300 F. For parts that require precision casting, where abrasion resistance is needed.

RED STREAK (Molybdenum-type tool steel)—Simonds Saw & Steel Co., Fitchburg, Mass.

Supplied in flat, ground stock. Finish, 25-35 micro-inches; wide hardening range, nondeforming. Supplied in thicknesses of 1/64 to 1 in. For machine parts such as levers, links, pawls, spinnets, cams, rollers, keys, etc.

Ground die steel; molybdenum type, nondeforming; oil hardening. Supplied in 18-in. long bars, in thicknesses ranging from ½ to 1¼ in. For variety of machine parts such as cams, cam rolls, pawls, links, levers, spinnets, etc.

RED-X (Aluminum alloys)—Apex Smelting Co., Cleveland 5, and Chicago 12.

No. 5; nominal composition; Si 5.5, Cu 1.5, Mg 0.3, Mn 0.3; furnished in ingots, for sand, permanent-mold, die, precision castings and forgings. When variously heat treated properties are: Ts, 29-48,000 psi; ys, 18-20,000 psi; elong, 1-7%; Bhn, 70-105. Endurance limit 10,000 psi at 100 million; sp gr, 2.70; nonmagnetic; weldability, good; heat resistant to 300 F. Machinability, good. Used for aircraft castings such as superchargers, pump housings, carburetors, engine and motor castings such as cylinder heads, blocks, crankcases, housings, etc., and intricate castings requiring pressure tightness.

No. 8; nominal composition; Si 8.0, Cu 1.5, Mg 0.3, Mn 0.3; furnished in ingots for sand, permanent-mold, die, precision castings and forgings. Various heat treated properties are: Ts, 28-49,000 psi; ys, 18-42,000 psi; elong, 1-6%; Bhn, 70-105; sp gr, 2.70; nonmagnetic; weldability, good; heat resistant to 350 F. Many variations of properties obtainable by application of different heat treatments. Has good casting and machining characteristics. Used for aircraft castings, such as superchargers, pump housings, carburetors, engine and motor castings, such as cylinder heads, blocks, crankcases, housings, and intricate castings requiring pressure tightness.

No. 10; nominal composition; Si 10, Cu 1.5, Mg 0.5, Mn 0.5; furnished in ingots for sand, permanent mold, die castings, forgings. Typical properties, heat treated; permanent mold, ts, 40,000 psi; ys, 30,000 psi; elong, 1.0; Bhn, 95; sp gr, 2.69; nonmagnetic; heat resistant to 400 F. For diesel, automotive, and small engine pistons and similar bearing parts because of its high strength and low coefficient of thermal expansion, and good abrasision resistance.

No. 13; nominal composition; Si 13, Cu 1.5, Mg 0.5, Mn 0.5; furnished in ingots for permanent mold and die castings. Typical properties, heat treated, permanent molds, ts, 40,000 psi; ys, 30,000 psi; Bhn, 95; sp gr, 2.69; nonmagnetic; heat resistant to 400 F. Uses same as Red X-10; lower coefficient of thermal expansion and better abrasion resistance.

REFRASIL (High-temperature insulating material)—The H. I. Thompson Co., Los Angeles 7.

High-silica-content all mineral insulation; withstands 2000 F indefinitely; is chemically stable; available in batts, cloth, tapes, sleeving, cordage, loose fiber, and in prefabricated blankets. For insulation of high temperature power equipment, hot gas duct insulation, filtration of gases at high temperatures, covering of high-temperature thermocouple lead wires, protection of electrical wire and equipment against heat, flame, and grounding; acoustical insulation at high temperatures; insulation of electric muffle furnaces.

REPUBLIC DOUBLE STRENGTH (Alloy steel)—Republic Steel Corp., Cleveland 1.

Low-carbon, Ni-Cu-Mo steel furnished in finished rods or bars, straight and coiled strip, tubing, sheet and plate; for machining, hot and cold working, stamping, drawing, and arc welding. In cold-worked state: Ts, 70,000 psi, min; ys, 50,000 psi, min; elong in 2 in., 22 %, min; magnetic resists corrosion caused by atmosphere; abrasion resistance, medium.

REPUBLIC ALDECOR (Alloy steels)—Republic Steel Corp., Cleveland 1.

Steel containing molybdenum, copper, silicon and phosphorus, furnished in rough bars or billets, finished rods or bars, straight and coiled strip, sheets and plates for turning, boring, forging, stamping and welding. In untreated state: Ts, 70,000 psi min; ys, 50,000 psi min; elong in 2 in., 22% min; sp gr is same as ordinary steel; weldability, good; resists corrosion caused by atmospheric exposure; abrasion resistance, medium. Used in transportation equipment to reduce dead-weight.

REPUBLIC COR-TEN (High strength steel)—Republic Steel Corp., Cleveland 1.

C 0.12 max, Mn 0.20-0.50, P 0.07-0.15, S 0.05 max, Si 0.25-0.75, Cu 0.25-0.55, Ni 0.65 max and Cr 0.50-1.25. Furnished in bars, sheet, strip, plate, structural and bar shapes for hot and cold forming, welding, riveting, etc. Resists atmospheric corrosion four to six times that of plain carbon steel; abrasion resistance, good; ys, 50,000 psi min; ts, 70,000 psi min; good ductility; weldability, good. Used for light-weight construction, with atmospheric corrosion resistance a major factor; structural and body members on mobile equipment.

RESILON (Thermoplastic plastics) — United States Stoneware Co., Akron 9.

Resinous thermoplastics; furnished in sheets and lumps to be molded and cast into machine parts; corrosion-resistant; flexible; high dielectric strength. Used for lining parts to resist corrosive attack.

RESIMENE (Melamine plastic molding compound)—Monsanto Chemical Co., Plastics Div., Springfield 2, Mass.

Particularly suitable for compression and transfer molding; widely used in automatic molding machines. Strength properties comparable to phenolics. Resistance to alkalies much better than other compression materials; excellent resistance to oils, greases, petroleum derivatives, alcohol, organic solvents and weak acids. Good electrical insulating properties particularly where arc resistance or nontracking is a factor. Color range from light to dark translucents and opaques.

RESINOX (Phenolic molding plastics)—Monsanto Chemical Co., Plastics Div., Springfield 2, Mass.

In standard and special formulas; thermosetting; heat-resistant; sp gr, 1.25-1.75; flexural str, 8000-15,000 psi; ts, 4200-8000 psi; impact str, 0.2-8.00 psi Izod test; water absorption, 0.01-0.6 (immersion 48 hours %). Used in electrical equipment, large housings, radio cabinets, etc. This tradename also refers to phenolic impregnating and treating resins.

RESIN X-2 (Adhesive)—Furane Plastics & Chemicals Co., Glendale 4, Calif.

A furane thermosetting plastic adhesive. Is particularly adapted for bonding thermosetting plastics and ceramic materials. Sets at room temperature; has high shear strength.

RESISTAC (Aluminum bronzes) — American Manganese Bronze Co., Philadelphia 86, Pa.

Three grades of aluminum bronze; available in sand castings, rods or bars and hammered forgings; strong; light. Resist certain acids and chemicals; retain strength at high temperatures; have excellent fatigue values. Compositions and physical characteristics for all grades are given below:

Nos. 1 and 2; Cu 85-90, Al 8-11, Fe 4 max; ts, untreated; 65-80,000 psi; ys, 28-35,000 psi; elong in 2 in., 20-30 per cent; impact resistance, medium; bhn, 120-150; nonmagnetic; weldability, fair; resists heat to 500 F; abrasion resistance, medium. Used for parts requiring high corrosion resistance, strength, and heat resistance, such as mill and valve guides; and for parts requiring good fatigue resistance.

No. 3; Cu 80 min, Al 8-10, Fe 5 max, Ni 5 max. Can be heat-treated by quenching from 1600 F, drawn at 700-1000 F, increasing strength and hardness but lowering ductility. In untreated state: Ts, 90,000 psi min; ys, 42,000 psi; elong in 2 in., 15 per cent; impact resistance, medium; bhn, 185 min; practically nonmagnetic; weldability, fair. Heat resistant to 500 F; abrasion resistance, low. For parts requiring high corrosion resistance and strength, such as gears, guides, etc.

RESISTAL (High-strength plastics) — Chemical Research Corp., Tulsa 1, Okla.

High-strength plastics having half the weight of aluminum, good electrical properties. Unaffected by all petroleum solvents, brines and acids and alkalies. Furnished in shets 1/64 to 2 in. in thickness, in sizes 46 x 46 in., and 30 x 72 in.

RESISTALOY (Aluminum-nickel yellow brass)—Titan Metal Mfg. Co., Bellefonte, Pa.

Cu 59, Al 2.00, Ni 1.00, Si 0.50, Fe 0.25, balance Zn. In cold-drawn state: Ts, 109-750 psi; ys, 85,000 psi; elong in 2 in., 14.5%; hardness, Rockwell B, 92-94. Exceptionally resistant to corrosion by sea water. For shafts, special bearings, forgings, bolts, nuts, studs, etc., on marine equipment.

RESISTOFELT (Laminated felt and Neoprene)—Western Felt Works, Chicago.

Used on revolving shafts; the felt lubricates the shaft and prevents entrance of dust; the Neoprene prevents passage of oil.

RESISTOFLEX (Elastomer)—Resistoflex Corp., Belleville, N. J.

Synthetic resin base, furnished in sheet and laminated form, and in rods, hose and tubes; abrasion resistance, high; impervious to oils, gasoline, and organic solvents; heat resistant to 250 F; flexibility, high; dielectric str, 10.7 volts per mil; ts, 5236 psi; moisture absorption, medium; sp gr, 1.259. For diaphragms, gaskets, oil, hydraulic, fuel, refrigeration and lubricating hose assemblies and molded parts.

RESISTRESS (Alloy steel castings)—Reliance Steel Casting Co., Pittsburgh.

Manganese-nickel-vanadium steel castings to specifications. Double normalized and tempered; ts, 90,000 psi; ys, 60,000 psi; elong in 2 in., 25%; bhn, 180. For machine parts subject to high stress and impact.

RESISTWEAR (Welding rods)—American Manganese Steel Div., American Brake Shoe Co., Chicago Heights, Ill.

Cr-Mo-Mn-C: For hard facing only; bhn, 400-500; martensitic steel deposits, magnetic; abrasion and impact resistant. For hard-facing ferrous parts subject to extreme wear.

No. 1: Co-Cr-W-Mn. For facing at elevated temperatures over 700 F; bhn, 500-540; resists acids, bases and salts; high creep strength; solid solution and eutecticform matrix anchoring very hard crystals of complex carbides. High resistance to liquid and hot gas corrosion, abrasion and high resistance to softening at temperatures up to 1800 F. For hard facing wire guides, pump sleeves, carbon scrapers, mandrels, lathe and grinder centers, etc.

No. 6: Co-Cr-W-Mn. For hard facing at elevated temperatures over 700 F; bhn, 420-450; resists acids, bases and salts; high creep strength, stainless solid solution matrix containing complete scattered eutectic carbides. High resistance to liquid and hot gas corrosion and good resistance to softening at high temperatures up to 1800 F. For hard facing high-pressure, high-temperature steam valves, hot trimming dies, shear blades, exhaust valves, valve seats, locomotive valve gears, etc.

RESNPREST (Plywood)—M & M Wood Working Co., Portland, Ore.

Phenol-formaldehyde bonded plywood; thermosetting; strong by unit weight; panel ⅛-in. thick and 12-in. sq weighs approximately 12 oz and supports over 400 lbs; widths to 72 in. (sanded) or 96 in. (unsanded); lengths to 144 in.; special scarfed panels to 50 ft. Thicknesses up to 9 in. made on high frequency thermal press for gusset plates, machine mountings, platforms, wood pulleys, spindles, etc. Cross-ply construction of material makes it splitproof and nails and screws can be fastened to very edge with safety. Has low moisture absorption. Used wherever rigidity and lightweight is needed. Bond is not affected by moisture, temperature, solvent, or exterior exposure.

RESPROID (Vinyl plastic)—Respro Inc., Cranston 10, R. I.

Furnished in sheets.

REVERE (Brasses)—Revere Copper & Brass Inc., New York 17.

Alloy No. 110: Gilding Brass; compared to copper this alloy has higher tensile strength, equal ductility, lower thermal properties. Physical properties depending on hardness; ts, 34-56,000 psi; ys, 10-50,000 psi; elong in 2 in., 45-5%; hardness, 46F-64B Rockwell; produced to ASTM specifications. Makes excellent base for articles to be gold plated or highly polished.

Alloy No. 120: Commercial Bronze; has excellent cold working properties, is very ductile. Available in sheet, strip, plate, rod, tube and forgings. Physical properties, depending on hardness; ts, 37-61,000 psi; ys, 10-55,000 psi; elong in 2 in., 50-5%; hardness, Rockwell 53F-70B; produced to ASTM specifications. Has excellent cold and hot working properties, poor machinability, is excellent for soldering and polishing. Is used for forging screws, weather stripping, stamped harware.

Alloy No. 130: Red Brass; offers higher strength and better ductility than copper; has excellent corrosion resistance often exceeding that of copper; is more successful at high temperature than higher zinc alloy. Physical properties depending on hardness, ts, 40-70,000 psi; ys, 10-58,000 psi; elong in 2 in., 55-5%; hardness, Rockwell 55F-77B; conforms to ASTM specifications. Has excellent cold working properties, good hot working properties, poor machinability, is excellent for soldering and polishing. Used for dials, hardware, etched parts, automobile radiators, tube and pipe for oil and utility fields and plumbing.

Alloy No. 140: Low Brass; has properties and qualities closely similar to those of Alloy No. 130.

Alloy No. 160: Cartridge Brass; has best combination of ductility and strength of any brass; excellent cold working properties, good hot working properties, fair machinability, and is excellent for soldering and polishing. Ts, 47-78,000 psi; ys, 15-64,000 psi; elong in 2 in., 65-8%; hardness, 64F-82B; conforms to ASTM specifications. Used

primarily for cartridge cases and ammunition components.

Alloy No. 170: Yellow Brass; available in sheet, strip, rod, wire and lock seam tubing. Possesses excellent cold working properties and good corrosion resistance. Physical properties depending on hardness; ts, 47-74,000 psi; ys, 15-60,000 psi; elong in 2 in., 65-8%; hardness, Rockwell 64F-80B; conforms to ASTM specifications. Has excellent cold working properties, poor hot working properties, fair machinability and is excellent for soldering and polishing. Used for deep drawing, spinning, etching, rolling and for practically all fabricating processes. Parts include pins, rivets, eyelets, auto radiator cores, heating units, lamp bodies and reflectors, cartridge cases and clips, electrical sockets, etc.

Alloy No. 180: Muntz Metal available in sheet, rod, tube, forgings, extruded shapes. Offers high strength combined with high ductility. Physical properties depending on hardness, ts, 54-80,000 psi; ys, 21-60,000 psi; elong in 2 in., 50-10%; hardness, Rockwell 80F-85B; conforms to ASTM specifications. Has fair cold working properties, excellent hot working properties, good machinability, and is excellent for soldering and polishing. Used for condenser tubes, valve stems, brazing rods, etc.

Alloy No. 224: Low-leaded Brass; offers free machining combined with moderate cold forming ability. Physical properties depending on hardness; ts, 47-75,000 psi; 15-60,000 psi; elong in 2 in., 60-7%; hardness, Rockwell 64F-80B; conforms to ASTM specifications. Has fair cold working properties, poor hot working properties, good machinability, poor weldability, and is excellent for soldering and polishing. For screw machine parts, electrical fuse parts, for pipes, pump liners, etc.

Alloy No. 235: High-leaded Brass; is free machining and has good blanking properties. Physical properties depending on hardness; ts, 49-74,000 psi; ys, 17-60,000 psi; elong in 2 in., 52-7%; hardness, 68F-80B Rockwell. Has poor cold working and hot working properties; excellent machinability, poor weldability and excellent for soldering and polishing. For engraving plates, name plates, keys, lock parts, tumblers, gears, parts for watches.

Alloy No. 240: Free-cutting Brass; has excellent machinability combined with good mechanical and corrosion resisting properties. Physical properties depending on hardness; ts, 49-58,000 psi; ys 18-45,000 psi; elong in 2 in., 53-25%; hardness, Rockwell 68F-78B; conforms to ASTM specifications. Has poor cold working properties, good hot working properties, excellent machinability, poor weldability, is good for soldering, excellent for polishing. Used for screw machine parts and other parts requiring free-cutting properties.

Alloy No. 280: Forging Brass; combines good corrosion resistance with excellent mechanical properties. Has fair cold working properties, excellent hot working properties, good machinability, poor weldability, is good for soldering and excellent for polishing. Used for hot forgings, hardware and plumbing goods.

Alloy No. 283: Architectural Bronze; has excellent forging and free machining properties. Very poor for cold working, excellent for hot working, poor weldability, excellent for soldering and polishing. Used for handrails, decorative moldings, grilles, revolving door parts, miscellaneous architectural trim, industrial extruded shapes such as hinges, lock bodies, automotive parts, etc.

Alloy No. 340: Chain Bronze; offers good combination of strength and ductility. Physical properties depending on hardness; ts, 45-67,000 psi; ys, 12-50,000 psi; elong in 2 in., 45-5%; hardness, 60F-80B Rockwell. Has good cold working properties, fair hot working properties, poor machinability, is excellent for soldering and polishing. Used for sash chain and other similar chains.

Alloy No. 358: Admiralty; excellent corrosion resistance combined with strength and ductility. Physical properties depending on hardness; ts, 50-100,000 psi; ys, 18-80,000 psi; elong in 2 in., 65-3%; hardness, Rockwell 25B-95B; conforms to ASTM specifications. Has good cold working properties, poor hot working properties, fair machinability, is weldable by gas and carbon arc, has good soldering and polishing characteristics. Used for condenser and heat exchanger plates and tubes, chemical and process equipment, various marine uses, automobile aerials, etc.

Alloy No. 380: Ronzan Bronze; has high resistance to fatigue and salt water corrosion. Physical properties depending on hardness; ts, 60-82,000 psi; ys, 22-65,000 psi; elong in 2 in., 45-20%; hardness, Rockwell 50B-80B; conforms to ASTM specifications. Has fair cold working properties, excellent hot working properties, good machinability, is excellent for soldering and polishing. Used for propeller and pump shafts, piston rods and a variety of marine uses.

Alloy No. 386: Naval Brass; has good resistance to salt water corrosion and is satisfactory for moderate cold working operations. Physical properties depending on hardness; ts, 57-90,000 psi; ys, 20-70,000 psi; elong in 2 in., 47-5%; hardness, Rockwell 45B-95B; conforms to ASTM specifications; has fair cold working properties, excellent hot working properties, good machinability and is excellent for soldering and polishing. Used for tube sheets and heat exchangers and steam condensers and for hot work forgings.

Alloy No. 389: Leaded Naval Brass; is similar to Alloy No. 240 but has increased strength and corrosion resistance. Physical properties depending on hardness; ts, 57-90,000 psi; ys, 20-70,000 psi; elong in 2 in., 40-5%; hardness, Rockwell 45B-90B; conforms to ASTM specifications. Has poor cold working properties, good hot working properties, excellent machinability, poor weldability and good soldering and polishing characteristics. For screw machine products, marine hardware, forgings, bolts, etc.

Alloy No. 454: Manganese Bronze; has high strength combined with excellent wear resistance. Physical properties depending on hardness; ts, 65-84,000 psi; ys, 30-60,000 psi; elong in 2 in., 33-19%; hardness, Rockwell 65B-90B; conforms to ASTM specifications. Has poor cold working properties, excellent hot working properties, good machinability and is excellent for soldering and polishing. Used for forgings, condenser plates, valve stems, coal screens, etc.

Alloy No. 435: Aluminum Brass; excellent corrosion resistance combined with good strength and ductility. Physical properties depending on hardness, ts, 60-85,000 psi; ys 27-60,000 psi; elong in 2 in., 55-10%; hardness, Rockwell 77F-86B; conforms to ASTM specifications. Has good cold working properties, fair hot working properties, poor machinability and is excellent for soldering. Used for condenser and heat exchanger tubes, steam power plant equipment, chemical and process equipment, and various marine uses.

REVERE (Bronzes)—Revere Copper & Brass Inc., New York 17.

Alloy No. 429: Aluminum Bronze; has high physical properties, high resistance to acids. Physical properties depending on hardness; ts, 50-85,000 psi; ys, 20-55,000 psi; elong in 2 in., 64-20%; hardness, Rockwell 40B-85B; conforms to ASTM specifications. Has good cold working properties, good hot working properties, fair machinability, good weldability; is good for soldering and polishing. For condenser tubes, high strength forgings, tie bolts, hardware bushings, etc.

Alloy No. 436: Aluminum-silicon Bronze; unusually high tensile strength, excellent corrosion resistance, is readily hot forged, rolled and extruded, and is free-machining. Physical properties depending on hardness; ts, 85-95,000 psi; ys, 43-53,000 psi; elong in 2 in., 35-25%; conforms to ASTM specifications. For bolts, nuts, gears, pinions, valve bushings, valve bodies and stems, marine hardware, sucker rods, etc.

Alloy No. 308: Phosphor Bronze; has high tensile strength, high resistance to corrosion and fatigue, low coefficient of friction, high immunity to season cracking. Physical properties depending on hardness; ts, 47-81,000 psi; ys, 19-75,000 psi; elong in 2 in., 64-10%; hardness, Rockwell 73F-87B; conforms to ASTM specifications. Used for diaphragms, bellows, lock washers, cotter pins, fuse clips, clutch disks, springs, screw machine stock, etc.

Alloy No. 315: Phosphor Bronze; corrosion and fatigue resistance high; coefficient of friction low; has high tensile strength. Physical properties depending on hardness; ts, 55-93,000 psi; elong in 2 in., 70-10%; hardness, Rockwell 75F-93B; conforms to ASTM specifications. Has excellent cold working properties, poor hot working properties, fair machinability, good weldability and is excellent for soldering and polishing. For springs, perforated sheets, bellows, cotter pins, fuse clips, bushings, lock washers, etc.

Alloy No. 325: Bearing Bronze; has high physical properties, is resistant to atmospheric corrosion and tarnish and has low friction coefficient. Physical properties depending on hardness; ts, 45-65,000 psi; ys, 10-57,000 psi; elong in 2 in., 42-5%; hardness, Rockwell 55F-76B. Has excellent cold and hot working properties, fair machinability, good weldability, is excellent for soldering and polishing, bushing material for light loads, weatherstrip applications, fuse clips, lamp connections, etc.

REVERE (Coppers)—Revere Copper & Brass Inc., New York 17.

Alloy No. 100: Has high electrical conductivity, high thermal conductivity, excellent workability, fair machinability. Properties, depending upon hardness; ts, 32-55,000 psi; ys, 10-50,000 psi; elong in 2 in., 55-6%; hardness, Rockwell 40F-60B. Conforms to ASTM specifications. Produced in sheet, strip, plate, rod, bus bars, tubing and forgings. Used for bus bars, commutators, kettles, vats, distillery equipment, printing rolls, etc.

Alloy No. 101: Produced in sheet, strip, rod and tube. Physical properties depending on hardness; ts, 32-55,000 psi; ys, 10-50,000 psi; elong in 2 in., 45-5%; hardness, Rockwell 40F-60B. Has better forming and bending qualities than Alloy No. 100; is preferred for copper smithing and welding. In tube form, is used for water and refrigeration service, heat exchange equipment and in oil burners. In sheet and plate form it is recommended for welded construction.

Alloy No. 103: Has high electrical conductivity, is resistant to embrittling gases at high temperatures; is excellent for deep drawing, provides superior glass-to-metal seal. Physical properties depending on hardness; ts, 32-50,000 psi; ys, 8-48,000 psi; elong in 2 in., 40-5%; hardness, Rockwell 40F-50B; produced to ASTM specifications. Has excellent cold and hot working properties, excellent for soldering and polishing, but has poor machinability. Used for special drawing and stamping, for sealing to glass, for electrical equipment at high temperatures in presence of reducing gases.

Alloy No. 105: Silver-bearing; is resistant to softening at temperatures from 500 to 700 F; has high conductivity. Physical properties depending on hardness; ts, 33-52,000 psi; ys, 7-48,000 psi; elong in 2 in., 40-5%; hardness, 40F-55B Rockwell; produced to ASTM specifications. Has excellent cold and hot working properties, fair machinability, excellent for soldering and polishing. Used for electrical commutators, automotive radiators and where retention of strength at moderately elevated temperatures is desired. Available in sheet, strip, rod and tube.

Alloy No. 106: Available in tube form only. Has low electrical conductivity. Physical properties depending on hardness; ts, 37-60,000 psi; ys, 8-48,000 psi; elong in 2 in., 42-4%; hardness, Rockwell 28F-95F; produced to ASTM specifications. Has excellent cold and hot working properties, poor machinability; is weldable by gas, metal arc and carbon arc processes, and is excellent for soldering and polishing. Used for certain condenser and heat exchanger applications.

Alloy No. 204: Free-cutting copper; similar to Alloy No. 103 but has free-cutting properties; has high electrical conductivity and high thermal conductivity. Physical properties depending on hardness, ts, 32-53,000 psi; ys, 7-49,000 psi; elong in 2 in., 40-7%; hardness, 40F-45B Rockwell; has good cold and hot working properties, excellent machinability; is not recommended for welding, has good soldering characteristics and is excellent for polishing. Used for screw machine parts, welding torch tips, interior parts for vacuum tubes, etc.

REVERE (Nickel alloys) — Revere Copper & Brass Inc., New York 17.

Alloy Nos. 533, 555, 535, 545, 548, 575. These are copper-zinc alloys with nickel added primarily for its influence on color. Color of these alloys is a silver-white. Nickel also improves mechanical properties and greatly increases resistance to corrosion and tarnish. Used for wide variety of stamped and formed machine parts.

Alloy No. 510: Cupro-nickel; has high strength and physical properties, high ductility and is resistant to corrosion erosion; its color is white-silver. Physical properties depending on hardness; ts, 54-80,000 psi; ys, 16-75,000 psi; elong in 2 in., 45-5%; Rockwell

hardness, 35B-85B; conforms to ASTM specifications. Excellent cold working properties, fair hot working properties, fair machinability, good weldability, excellent for soldering and good for polishing. For condenser tubes and plates, tanks, vats, vessels, and process equipment. Also for automotive parts, nuts, bolts, screws, meters, refrigerator pump valves, etc.

REXARC (Overlay electrodes)—The Sight Feed Generator Co., Richmond, Ind.

Welding rod having overlay hardness of 300-670 Brinell. Overlay is hard and tough. For bucket teeth lips, caterpillar rollers, crusher rolls and jaws, etc.

REX Z METAL (Corrosion-resistant castings)—Chain Belt Co., Milwaukee 4.

Furnished as castings; resists corrosion caused by weather and inorganic acids to a degree; resists heat to 800 F; high abrasion resistance; ts, 80,000 psi; medium ductility; sp gr, 7.45; good bearing properties; Bhn, untreated, 200. For cast parts requiring high strength and good machinability.

REYNOLDS (Wrought aluminum alloys)—Reynolds Metals Co., Louisville 1, Ky.

28; available in flat and coiled sheet, plate, flattened wire, drawn wire, rolled rod, bar and rivets.

38; available in flat and coiled sheet, plate, flattened wire, drawn wire, rolled rod and bar, extruded rod, bar and shapes, tubing and pipe.

148; available in extruded rod, bar and shapes, forging stock, tubing and pipe.

178; available in flattened wire, drawing wire, rolled rod and bar, screw machine stock, rolled structural shapes.

A17ET; available in rivets.

188; available in forging stock.

248; available in flat and coiled sheet, plate, flattened wire, drawn wire, rolled rod and bar, extruded bar, rod and shapes, tubing and pipe.

Pure clad 248; available in flat and coiled sheet, plate.

258; available in forging stock.

328; available in forging stock.

A518; available in forging stock.

528; available in flat and coiled sheet, plate, flattened wire, drawn wire, rolled rod and bar and tubing.

638; available in extruded rod, bar and shapes, tubing and pipe.

Hard Clad R301; available in flat and coiled sheet, plate.

R317; available in drawn wire, rolled rod and bar, screw machine stock.

R361; available in flat and coiled sheets, plate, flattened wire, drawn wire, rolled rod and bar, extruded rod, bar and shapes, rolled structural shapes, forging stock, tubing and pipe, rivets and nails.

REZISTAL (Stainless steel)—Crucible Steel Co. of America, New York.

Stainless steels in standard forms to AISI Specifications. For data on types, properties and characteristics see "Stainless Steels" listing at end of this section.

RIGIDIZED Metal (Sheet or strip)—Rigid-Tex Corp., Buffalo 3.

Ferrous or nonferrous in sheet or strip, solid or perforated, up to 36 in., in width; any length. Material embossed with variety of "rigidizing" and decorative patterns.

RIVER RS BRAND (Solder)—The River Smelting & Refining Co., Cleveland 1.

Solder in bar form, produced to SAE and ASTM Specifications. Used for joining steel, brass, copper and aluminum.

RIVERSIDE (Nonferrous alloys) — Riverside Metal Co., Riverside, N. J.

Phosphor bronze, nickel silver and beryllium copper in sheet, strip, wire and rod form.

ROCKRITE (Seamless tubing)—Tube Reducing Corp., Wallington, N. J.

In SAE-52100 steel analysis; furnished in seamless tubing (cold reduced), for machining into outer and inner raceways of ball bearings. Hardness as furnished, Rockwell C, 27-31, depending upon size and gage. For bearing raceways, sleeves, cylindrical tool parts, or any parts which are to be subjected to wear or abrasion. When quenched in oil, at 1540 F, resulting hardness is the equivalent of Rockwell C 65, which hardness can be lowered according to tempering temperature.

Also in plain carbon steel, such as SAE X-1020; ts, 110,000 psi; ys, 90,000 psi; elong in 2 in., 10 to 12%.

ROSITE (Inorganic plastics) — Rostone Corp., Lafayette, Ind.

Compression custom molded calcium-aluminosilicate plastics. Resistant to alkalies; max cont serv temp, 900 F; dielectric strength (volts per mil. inst.), 80; ts, 1000 psi; comp str, 12-15,000 psi; available in a variety of pastel shades; moisture absorption, low; sp gr, 1.6; is opaque; machinability, fair. Dimensionally stable, accurately molded, non-carburizing. For electrical insulators, particularly where heat and arc resistance are needed.

ROSSLYN METAL (Clad metal)—American Cladmetals Co., Carnegie, Pa.

A combination of chrome-nickel grades of stainless steel inseparably bonded to high conductivity copper interlayer. Fabrication into sheets of Standard AISI Types of stainless steel, 302, 304, 305, 308, 321, 347, etc. Used for jet plane parts, refrigeration units, high pressure canning equipment, heat conveying and heat dissipating equipment, etc.

ROSS-MEEHAN (Manganese cast steels)—Ross-Meehan Foundries, Chattanooga, Tenn.

Medium-manganese cast steel; C 0.40-0.50, Mn 1.40-1.60, furnished as sand castings. Heat treated to requirements. In untreated state: Ts, 90,000 psi; ys, 55,000 psi; elong in 2 in., 22 per cent; impact str, 15 ft-lb (Charpy); bhn, 220; max cont serv temp, 750 F; Abrasion resistance, high. For sprockets, clutches, rollers, worms or other parts requiring wear resistance and strength where shock loading is not too high.

Manganese-molybdenum cast steel; C 0.30-0.40, Mn 1.40-1.60, and Mo 0.30-0.40; furnished as sand castings; heat treated to requirements. In untreated state: Ts, 90-100,000 psi; ys, 55-65,000 psi; elong. in 2 in., 22 per cent; impact str, 25 ft-lb (Charpy); bhn, 220; weldability, good; max cont serv temp, 750 F; abrasion resistance, medium. For machine parts such as frames, yokes, couplings, fittings, etc., where strength and impact resistance are requfred.

Manganese-vanadium cast steel; C 0.22-0.27, Mn 1.60-1.80, and V 0.10-0.15, furnished as sand castings, heat treated to requirements. In untreated state: Ts, 90,000 psi; ys, 55,000 psi; elong in 2 in., 25 per cent; impact str, 50 ft-lb (Charpy); bhn, 207; weldability, fair; abrasion resistance, low. For parts requiring good strength and good resistance to impact loading.

ROTOMETALS (Solder)—Rotometals, Inc., San Francisco 7.

Tin-lead solder of all grades supplied in rod and bars and strip. For joining sheet metal, electrical connections, etc.

RS (Radio spaghetti)—Irvington Varnish & Insulator Co., Irvington, N. J.

Braided cotton sleeving coated with a smooth, continuous, lacquer film; conforms to ASTM and VTA specifications for Grade B-2 flexible varnished tubing; highly resistant to aging; obtainable in five colors.

RUBEROID (Insulating tape) — Ruberoid Co., New York 18.

Electrical insulating tape. Abrasion and chemical resistance, high; max cont serv temp, 212 F; flexibility, high; high dielectric, tensile, transverse and flexural strengths; available in black, opaque; shatterproof.

RUB-EROK (Rubber)—The Richardson Co., Melrose Park, Ill.

Hard rubber molded into parts, possessing high dielectric strength; low moisture absorption, low loss factor. Used for electrical insulation. Particularly desirable for electrical, heat and cold insulation; for industrial uses.

RUBYFLUID (Solder)—The Ruby Chemical Co., Columbus 8, O.

Tin-lead solder in wire form with cored center flux; acid or rosin core; for all metals except aluminum.

RURALDUCTOR (Stranded steel conductor)—Bethlehem Steel Co., Bethlehem, Pa.

For rural power lines.

RYERSON (Steels)—Joseph T. Ryerson & Son Inc., Chicago 80.

Stocks of carbon, alloy and stainless steels in all standard forms. Complete hardenability data furnished with annealed and as-rolled alloys. (For property and application data on stainless steels see "Stainless Steels" listing at end of this section).

RYERTEX (Laminated plastics)—Joseph T. Ryerson & Son Inc., Chicago 80.

Phenolic type laminated plastics, furnished in sheets, strips, plates, rods or tubes, for molding and machining. Abrasion resistance, high; chemical resistance, high; max cont serv temp, 275 F; slow burning; flexibility, medium; ts, 11,000 psi; comp str, 40,000 psi; flexural str, 21,000 psi; moisture absorption, low; available in natural color; shatterproof; machinability, good. For heavy and light-duty bearings either water or oil lubricated. Also for abrasion and or chemical resistance applications.

S

SABECO (Bearing bronzes)—Saginaw Bearing Co., Saginaw, Mich.

No. 5 bearing bronze: Cu 69-71, Sn 4.5-5.5. Pb 24-26 max, impurities 0.2. For light or medium-load and water-lubricated bearings.

No. 7: For connecting rods in refrigerating compressors and gasoline engines.

No. 9: Cu 69.71, Sn 8.5-9.5. Pb 20-22 max. impurities 0.2. For heavy loads such as average machine tool requirements.

No. 11: Cu 69-71, Sn 10.5-11.5, Pb 18-20 max, impurities 0.2. For worm wheels, clutch shifter shoes, forging machine slides, and extreme heavy bearing conditions.

No. 16: Cu 69-71, Sn 15-16.5, Pb 13.5-14.5 max, impurities 0.2. For friction rings, and heavy-duty boring spindle bearings.

SAFETEE (Glass and mirrors)—Safetee Glass Co., Philadelphia 44.

Laminated shatter-resistant glass mirrors to specification. Also a laminated, shatter-resistant glass in form of sheets and plates produced in many colors, transparent, translucent, or opaque.

SAFLEX (Thermoplastic plastics sheet)—Monsanto Chemical Co., Plastics Div., Springfield 2, Mass.

Polyvinyl acetal thermoplastic sheet material, below zero to over 120 F.

ST. MARYS (Carbon, graphite, and metal-graphite products)—St. Marys Carbon Co., St. Marys, Pa.

Pressed and sintered parts made of graphite, copper and other materials blended to produce the type of material required for specific applications. For pressure contact, bearings, seals, resistors, etc.

SANDEE (Thermoplastic plastics)—Sandee Mfg. Co., Chicago.

K4: vinyl base; heat resistant to 150 F; flexibility, high; ts, at 25 C, 1500 psi; moisture absorption low; available in color; sp gr, 1.22. In rods and tubes for electrical insulation and for replacing rubber tubing and gaskets.

T-2; collulose acetate butyrate; in rods, or tubes and custom shapes and sections; heat-resistant to 140 F; flexibility, low; dielec-

tric str, 250-400 volts per mil; ts 2600-6700 psi; moisture absorption, low; available in color; shatterproof; sp gr, 1.15-1.24. For manometer tubes, refrigerator moldings, truck body moldings, etc.

M.M.: Methyl methacrylate thermoplastic furnished in the form of rod, tubes and industrial shapes. Abrasion resistance, medium; chemical resistance, good; max cont serv temp, 120-185 F; flexural str, 14-17,000 psi; dielectric str, 450-500 volts per mil, inst.; ts, 7,500-10,000 psi; comp str, 12-18,000 psi; impact str. (Izod), 0.4-0.5 ft lb; produced in wide range of colors; low moisture absorption; sp gr, 1.18-1.19; transparent, translucent and opaque; machinability, good; bhn, 18-20; coefficient of thermal expansion, 8-9 x 10^{-5} inch/inch/degree C.

E.C.: Ethyl cellulose thermoplastic furnished in the form of rods, tubes and industrial shapes. Abrasion resistance, high; chemical resistance, good; max cont serv temp, 150-160 F; dielectric str, 470-550 volt per mil, inst; ts, 2500-8000 psi; produced in wide range of color, translucent and opaque; moisture absorption, medium; sp gr, 1.08-1.18; machinability, good; coefficient of thermal expansion, 10-14 x 10^{-5} inch/inch/degree C. Has high toughness, good insulation properties, flexibility and resistance to inks. For moldings, refrigerator breaker strips, handles, knobs, insulator parts, etc.

S: Polystyrene thermoplastic; produced in rods, tubes and industrial shapes. Abrasion resistance, medium, chemical resistance, good; cont serv temp, 150-160 F; flexural str, 8000-9500 psi; dielectric str, 500-700 volts per mil, inst; ts, 5500-7000 psi; produced in wide range of colors; moisture absorption, low, sp gr, 1.070; is transparent, translucent and opaque; coefficient of thermal expansion, 6-8 x 10^{-5} inch/inch/degree C. Offers good moisture resistance, dimensional stability, surface hardness, acid resistance, alkali resistance, and high volume resistivity. Used for insulator parts, light shields, etc.

SANDUSKY (Cast nonferrous alloys)—Sandusky Foundry & Machine Co., Sandusky, O.

Centrifugally cast bronze, brass and Monel sleeves, liners, tubes, bushings and roll covers from 3 to 54 in. diam. in lengths up to 327 in. depending upon diameters and metal composition. Rings are available from 3 to 72 in. diam. Improved physical properties and machinability resulting from the Sandusky process.

Also bearing metals, copper-base metals and nickel base metals.

SANTOCEL (Insulation)—Monsanto Chemical Co., Everett Station, Boston 49.

Silica Aerogel amorphous powder having high chemical resistance and high fire resistance; moisture absorption, low; is translucent. Max cont serv temp, 1300 F. Used in refrigerators, freezers, stratosphere chambers, frozen food lockers, thermos jugs, railroad tank cars, liquefied gas storage and shipping containers. Thermal conductivity is less than that of still air.

SARAN (Polyvinylidene chloride plastics)—The Dow Chemical Co., Midland, Mich., and licensees.

Crystalline, thermoplastic, aliphatic chloride with polymeric base; furnished in special extruded and molded forms; material is corrosion-resistant; very tough and flexible; ts, to 50,000 psi (extruded); low moisture absorption; abrasion-resistant; takes high polish; high dielectric strength; shatterproof; non-inflammable; available in color; transparent to opaque. Used for moldings, gaskets, packings, tubing, belting, fabrics from extruded monofilaments; etc. Licensees: Acadia Synthetic Products Div., Western Felt Works, Chicago; American Hard Rubber Co., New York; Elmer E. Mills Co., Chicago; Firestone Industrial Prods., Akron, O.; National Plastic Products Co., Odenton, Md., Parker Appliance Co., Cleveland; St. Louis Plastic Molding, St. Louis; Celluplastic Corp., Newark 5, N. J.; Firestone Tire & Rubber, Ltd., Hamilton, Ontario; Goodyear Tire & Rubber Co., Akron, O.; Commercial Plastics Co., Chicago, Ill.; The Visking Corp., Chicago, Ill.; American Extruded Products Co., Los Angeles, Calif.; Lus-Trus Extruded Plastics, Inc., Ann Arbor, Mich.; The Pantasote Leather Co., Passaic, N. J.

SATCO (Lead-base bearing alloy)—Magnus Metal Corp., Chicago.

Contains from 94-98 per cent lead, with balance tin, calcium and other auxiliary hardeners; melting point about 125 degrees higher than that of tin-base and lead-base babbitt metals, with higher resistance to deformation and wiping at elevated temperature. Material is furnished in ingot form and also lined bearings. Mechanical properties in untreated states: ts, 11-13,000 psi; comp str, 15-17,000; elongation, 8-12 per cent; bhn, 22-24. Recommended as a lining for brass, bronze and steel back bearings. May be used as a substitute for lead and tin base babbitts, block tin and other bearing metals.

SCOVILL (Copper-base alloys)—Scovill Mfg. Co., Waterbury 91, Conn.

Alloy No. 110: Available in strip, rod, wire and tubing; Cu 95, Zn 5. Ts, (soft .035mm) 35,000 psi, (hard) 55,000 psi; Rockwell hardness, (soft .035mm) F52, (hard) B60; coef of expansion, 18.1 x 10^{-6}; electrical conductivity, 55% IACS.

Alloy No. 120: Available in strip, rod, wire and tubing; Cu 90, Zn 10. Ts, (soft .035mm) 38,000 psi, (hard) 62,000 psi; Rockwell hardness, (soft .035mm) F60, (hard) B70; coef of expansion, 18.4 x 10^{-6}; electrical conductivity, 41% IACS.

Alloy No. 130: Available in strip, rod, wire and tubing; Cu 85, Zn 15. Ts, (soft .035mm) 41,000 psi, (hard) 70,000 psi; Rockwell hardness, (soft .035mm) F63, (hard) B76; coef of expansion, 18.7 x 10^{-6}; electrical conductivity, 37% IACS.

Alloy No. 140: Available in strip, rod, wire and tubing; Cu 80, Zn 20. Ts, (soft .035mm) 43,000 psi, (hard) 72,000 psi; Rockwell hardness, (soft .035mm) F66, (hard) B76; coef of expansion, 18.7 x 10^{-6}; electrical conductivity, 30% IACS.

Alloy No. 160: Available in strip, rod, wire and tubing; Cu 70, Zn 30. Ts, (soft .035mm) 49,000 psi, (hard) 76,000 psi; Rockwell hardness, (soft .035mm) F68, (hard) B82; coef of expansion, 19.9 x 10^{-6}; electrical conductivity, 28% IACS.

Alloy No. 169: Available in strip, rod and wire; Cu 65, Zn 35. Ts, (soft .035mm) 49,000 psi, (hard) 76,000 psi; Rockwell hardness, (soft .035mm) F68, (hard) B82; coef of expansion, 20.5 x 10^{-6}; electrical conductivity, 25% IACS.

Alloy No. 215: Available in rod and wire; Cu 89, Pb 2 Ni 1, Zn 8. Ts, (soft .035mm) 37,000 psi, (hard) 62,000 psi; Rockwell hardness, (soft .035mm) F55, (hard) B70; coef of expansion, 18.4 x 10^{-6}; electrical conductivity, 37% IACS.

Alloy No. 234: Available in rod and wire; Cu 85, Pb 1¾, Zn 13⅛. Ts, (soft .035mm) 40,000 psi, (hard) 65,000 psi; Rockwell hardness, (soft .035) F63, (hard) B67; coef of expansion, 18.7 x 10^{-6}; electrical conductivity, 37% IACS.

Alloy No. 235: Available in strip; Cu 73, Pb 2¾, Zn 24¼. Ts, (soft .035mm) 44,000 psi, (hard) 75,000 psi; Rockwell hardness (soft .035mm) F65 (hard) B82; coef of expansion, 19.6 x 10^{-6}; electrical conductivity, 28% IACS.

Alloy No. 252: Available in strip, rod and wire; Cu 65, Pb 1, Zn 34. Ts, (soft .035mm) 49,000 psi, (hard) 74,000 psi; Rockwell hardness, (soft .035mm) F68, (hard) B80; coef of expansion, 20.3 x 10^{-6}; electrical conductivity, 25% IACS.

Alloy No. 276: Available in rod and wire; Cu 61½, Pb 3, Zn 35½. Ts, (soft .035mm) 49,000 psi, (hard) 58,000 psi; Rockwell hardness, (soft .035mm) F70, (hard) B78; coef of expansion, 20.5 x 10^{-6}; electrical conductivity, 25% IACS.

Alloy No. 284: Available in rod and wire; Cu 60, Pb 2, Zn 38. Ts, (soft .035mm) 46,000 psi, (hard) 62,000 psi; Rockwell hardness (soft .035mm) F75, (hard) B78; coef of expansion, 20.6 x 10^{-6}; electrical conductivity, 25% IACS.

Alloy No. 363: Available in strip and tubing; Cu 71, Sn 1, Zn 28, P 0.03. Ts, (soft .035mm) 50,000 psi, (hard) 83,000 psi; Rockwell hardness, (soft .035mm) F70, (hard) B84; coef of expansion, 20.2 x 10^{-6}; electrical conductivity, 25% IACS.

Alloy No. 381: Available in rod, wire and tubing; Cu 60, Sn ¾, Zn 39¼. Ts, (soft .035mm) 58,000 psi, (hard) 75,000 psi; Rockwell hardness, (soft .035mm) F80, (hard) B82; coef of expansion, 21.2 x 10^{-6}; electrical conductivity, 26% IACS.

Alloy No. 412: Available in strip, rod and wire; Cu 95, Sn 5, P 0.35 max. Ts (soft .035mm) 50,000 psi, (hard) 86,000 psi; Rockwell hardness (soft .035mm) F77, (hard) B87; coef of expansion, 17.8 x 10^{-6}; electrical conductivity, 18% IACS.

Alloy No. 416: Available in strip, rod and wire; Cu 92, Sn 8, P 0.25 max. Ts (soft .035mm) 58,000 psi, (hard) 95,000 psi; Rockwell hardness (soft .035mm) F80, (hard) B93;coef of expansion, 18.2 x 10^{-6}; electrical conductivity, 13% IACS.

Alloy No. 510: Available in strip, rod and wire; Cu 65, Ni 5, Zn 30. Ts, (soft .035mm) 45,000 psi, (hard) 93,000 psi; Rockwell hardness, (soft .035mm) F64, (hard) B86; coef of expansion, 16.8 x 10^{-6}; electrical conductivity, 12% IACS

Alloy No. 520: Available in strip, rod and wire; Cu 65, Ni 10, Zn 25. Ts, (soft .035mm) 50,000 psi, (hard) 93,000; Rockwell hardness, (soft .035mm) F76, (hard) B89; coef of expansion, 16.4 x 10^{-6}; electrical conductivity, 8% IACS.

Alloy No. 525: Available in strip, rod and wire; Cu 65, Pb 1, Ni 12, Zn 22. Ts, (soft .035mm) 55,000 psi, (hard) 82,000 psi; Rockwell hardness, (soft .035mm) F80, (hard) B86; coef of expansion, 16.2 x 10^{-6}; electrical conductivity, 6% IACS.

Alloy No. 530: Available in strip, rod and wire; Cu 65, Ni 15, Zn 20. Ts, (soft .035mm) 50,000 psi, (hard) 89,000 psi; Rockwell hardness, (soft .035mm) F70, (hard) B88; coef of expansion, 16.2 x 10^{-6}; electrical conductivity, 6% IACS.

Alloy No. 535: Available in strip, rod and wire; Cu 65, Ni 18, Zn 17. Ts, (soft .035mm) 58,000 psi, (hard) 85,000 psi; Rockwell hardness, (soft .035mm) F85, (hard) B87; coef of expansion, 16.2 x 10^{-6}; electrical conductivity, 6% IACS.

Alloy No. 537: Available in strip, rod and wire; Cu 55, Ni 18, Zn 27. Ts, (soft .035mm) 60,000 psi; (hard) 100,000 psi; Rockwell hardness, (soft .035mm) F90, (hard) B91; coef of expansion, 16.7 x 10^{-6}; electrical conductivity, 5½% IACS.

Alloy No. 640: Available in strip and tubing; Cu 80, Ni 20. Ts, (soft .035mm) 49,000 psi, (hard)) 72,000 psi; Rockwell hardness, (soft .035mm) F73, (hard) B81; coef of expansion, 16.2 x 10^{-6}; electrical conductivity, 6% IACS.

Alloy No. 660: Available in strip and tubing Cu 70, Ni 30. Ts, (soft .035mm) 58,000 psi, (hard) 80,000 psi; Rockwell hardness, (soft .035mm) F80, (hard) B84; coef of expansion, 16.2 x 10^{-6}; electrical conductivity, 5% IACS.

S. C. P. (Carbon)—Superior Carbon Products, Inc., 9115 George Avenue, Cleveland, Ohio.

Furnished in rods and plates; max cont serv temp, below 1200 F; tranverse strength 2000-4000 psi; moisture absorption, low; furnished in black only; hardness, 10-100 Scleroscope. For seal rings, bearings, molds, pump vanes, valve seats, electrodes, carbon brushes, etc.

SEALMET (Special alloy steel)—Allegheny Ludlum Steel Corp., Brackenridge, Pa.

Typical analysis—Cr 27, balance Fe. Alloys having same coefficient of expansion as certain grades of glass. For application where metal wires or strip must be attached directly to glass.

SEALON (Liquid copolymer) — Maurice A. Knight Co., Akron 9, O.

Heavy viscosity liquid; for dipping, spraying, brushing then curing at 350 F in oven heat for 20 to 30 min per coat. Abrasion resistance, good; chemical resistance, very good; max cont serv temp, between 200 and 250 F; available in green, black and white; moisture absorption, quite low; opaque. For agitators, fans, handles and for bonding to steel, copper, brass and aluminum.

SELECTRON (Plastic resins)—Pittsburgh Plate Glass Co., Pittsburgh.

A series of transparent, fast-curing thermosetting resins which can be used for many industrial applications. Selectron (5000 Series) resins are of the copolymer type, furnished and applied as 100% solids and cured at moderate temperatures without the elimination of water and other volatile byproducts. They may be cured with or without pressures, pigments, dyes, fillers or reinforcing materials. Selectron monomers are available at almost any viscosity with different adhesive qualities. Resins can be applied in impregnating, laminating, casting or molding operations, or as adhesives.

SELFLUBE (Bearing metal)—Keystone Carbon Co., Saint Marys, Pa.

Self-lubricating porous bronze, brass and iron bearing metal; oil content is to 35% by

volume. Iron, brass, bronze structural parts. Bearings and parts held to close dimensions; used in automobiles, airplanes, business machines, household appliances, electric motors, clocks, farm implements, textile machinery, etc.

SEMINOLE HARD (Oil-hardening steel)—Allegheny Ludlum Steel Corp., Brackenridge, Pa.

C 0.50, Si 0.80, Cr 1.30, W 2.25, V 0.25. For high creep strength bolts and studs for superheated steam; for various machine parts subject to repeated shock and wear. Withstands moderately elevated temperatures—intermittent up to about 900 F. Should be hardened in oil.

SEYMOUR (Nickel silvers)—Seymour Mfg. Co., Seymour, Conn.

Alloy No. 5: Cu 61, Zn 34, Ni 5; furnished in wire form; in spring temper, ts, 135,000 psi; elong in 2 in., 2%; electrical conductivity (IACS), 12%.

Alloy No. 10A1: Cu 67, Zn 23, Ni 10; furnished in sheet, wire and rod; in spring temper, ts, 109,000 psi; elong in 2 in., 1.5%; Rockwell hardness, B 88; sp gr, 8.64; electrical resistivity (IACS), 11.1; electrical conductivity (IACS), 9%.

Alloy No. 12X1: Cu 61, Zn 26, Ni 12, Pb 1; furnished in rod form only; hard drawn temper, ts, 90,000 psi; elong in 2 in., 5%; Rockwell hardness, B 87.

Alloy No. 15A: Cu 64, Zn 21, Ni 15; in spring temper, ts, 93,000 psi; elong in 2 in., 5%; Rockwell hardness, B 90; sp gr, 8.70; electrical resistivity (IACS), 15.9; electrical conductivity (IACS), 6.3%; furnished in sheet, wire and rod.

Alloy No. 15X1: furnished in rod form; cu 60, Zn 24, Ni 15, Pb 1; in hard drawn temper, ts, 85,000 psi; elong in 2 in., 10%; Rockwell hardness, B 80; electrical resistivity (IACS), 16.7; electrical conductivity (IACS) 6%.

Alloy No. 18A1: furnished in sheet, wire and rod; Cu 65, Zn 17, Ni 18; in half-hard temper, ts, 70,000 psi; elong in 2 in., 10%; sp gr, 8.75; Rockwell hardness, B 80.

Alloy No. 18A4: furnished in sheet and wire form; Cu 55, Zn 27, Ni 18; in spring temper, ts, 110-145,000 psi; elong in 2 in., 2.3%; sp gr, 8.68; electrical resistivity 18.2; electrical conductivity (IACS), 5.5%.

Alloy No. 18X1: Furnished in rod form; Cu 62, Zn 19, Ni 18, Pb 1. In hard drawn temper, ts, 85,000 psi; elong in 2 in., 13%; hardness, Rockwell B 80; electrical resistivity (IACS), 17.6; electrical conductivity (IACS), 5.7%.

Alloy No. 18A7: Furnished in sheet, rod and wire; Cu 72, Zn 10, Ni 18; in spring temper, ts, 80-115,000 psi; elong in 2 in., 2-7%; sp gr, 8.83; electrical resistivity (IACS), 16.2; electrical conductivity (IACS), 6.2%.

SEYMOUR (Phosphor bronzes)—Seymour Mfg. Co., Seymour, Conn.

Alloy No. 444: Cu 88, Zn 4, Pb 4; in hard drawn temper (small sizes) ts, 60,000 psi; elong in 2 in., 20%; hardness, Rockwell B 75; sp gr, 8.86; electrical resistivity (IACS), 8.2; electrical conductivity (IACS), 12.2%.

Alloy No. 494: Cu 94, Sn 5, Pb 1; in hard drawn temper, ts, 61,000 psi; hardness, Rockwell B 85; electrical resistivity (IACS), 6; electrical conductivity (IACS), 16.8%.

Alloy No. 910: Cu 90, Sn 10; in spring temper, ts, 115,000 psi; elong in 2 in., 5%; hardness, Rockwell B 100; sp gr, 8.76; electrical resistivity (IACS), 9.4; electrical conductivity (IACS), 10.6%.

Alloy No. 928: Cu 92, Sn 8; in spring temper, ts, 112,000 psi; elong in 2 in., 3%; hardness, Rockwell B 98; sp gr, 8.80; electrical resistivity (IACS), 7.8; electrical conductivity (IACS), 12.8%.

Alloy No. 950: Cu 95, Sn 5; in spring temper, ts, 105,000 psi; elong in 2 in., 1.5%; hardness, Rockwell B 95; sp gr, 8.86; electrical resistivity (IACS), 6.1; electrical conductivity (IACS), 16.5%.

S-G (Cast carbon steels)—The Symington-Gould Corp., Rochester 3, N. Y.

Grade B: As normalized, has following properties: Ts, 70,000 psi; ys, 38,000 psi; elong in 2 in., 24%; reduction of area, 36%.

High-tensile: As normalized and drawn, properties are: Ts, 90,000 psi; ys, 60,000 psi; elong in 2 in., 22%; reduction of area, 45%.

"SHAMVA" MULLITE (Ceramic refractory)—The Mullite Refractories Co., Shelton, Conn.

Furnished in grain, cement, bricks and special shapes, Abrasion resistance, high; is chemically neutral; softening temperature, 3250 F; dielectric str, better than mica; available in natural color only; sp gr, varies with type, 2.77-2.30; machinability, poor; hardness, Moh's hardness scale, 6-7, coefficient of thermal expansion, 0.00000366-in. per in. per in. per degree C. Used for feeder parts in glass molding machines.

SHARON (Steels)—Sharon Steel Corp., Sharon, Pa.

All standard carbon, alloy and stainless steels in standard forms. Furnished in straight and coiled strip and sheets for machining, hot and cold working, stamping, drawing, brazing, and arc, gas and resistance welding. For data on properties, characteristics, and applications of stainless sheets see "Stainless Steels" listing at end of this section.

SHELL DIE (Alloy steel)—A. Finkl & Sons Co., Chicago.

Cr 4.50-5.00, high Si and Mo; normalized or quenched in oil or in air blast. For shell punches, mandrels and die inserts.

SHELL-PLI (Laminated plastics) — Shellmar Products Corp., Mount Vernon, O.

Thermosetting, polyester-base laminated plastics in sheet form; abrasion resistance, medium to high; chemical resistance, excellent; max cont serv temp, 250-350 F depending upon grade; flex str, 10-40,000 psi depending upon grade; dielectric str, 150-400 volts per mil; ts, 8-50,000 psi; comp str, 16-90,000 psi; impact str, (Izod), 1-45 ft-lb per inch of notch; produced in unlimited colors; moisture absorption, low; sp gr, 1.2-1.5; translucent and opaque; hardness (Barcol) up to 60.

SHENANGO-PENN (High strength alloy castings)—Shenango-Penn Mold Co., Dover, O.

Centrifugal castings in all bronzes, Monel Metal and Meehanite metals—A complete range of red bronze alloys, as well as yellow metals including manganese bronzes and aluminum bronzes. Also special alloys such as aluminum and silicon bronzes, copper, etc. Grades of plain and alloy iron, as well as Ni-Resist are available. Furnished in cast tubular bars or cylinders in sizes from 2-26 in. OD and to 26 ft in length; solid bars in diameters ranging from ½ to 8 in. —in standard 6-ft lengths. For immediate delivery stock of both solid and tubular bars under 6¾ in. OD is maintained. Can be adapted to any application where castings are used. Flanges and unusual shapes of various sizes also available. For bearings, bushings, drums, liners, roll covers, sleeves, washers, rings, etc.

SHIELD-ARC (Welding electrode)—Lincoln Electric Co., Cleveland.

Type 85; high tensile welding rod; recommended for fabrications of high tensile steels; bhn, 190-250; ts, 77-82,000 psi.

Type 100; bhn, 235-300; ts, 103-112,000 psi.

Type LH-70; for welding high carbon, high sulphur steels of poor welding quality; ts, 75-80,000 psi.

SHOBER (Welding electrodes)—Shober Sales Inc., Stockton, Calif.

Mild steel welding electrodes furnished in 1/16 to ⅝-in. diam rods. Strengths of welded joints: Ts, 65-75,000 psi; ys, 55-65,000 psi.

SHOCKPROOF (Malleable iron)—The Lake City Malleable Co., Cleveland 14.

Malleable iron within ASTM Specifications No. 32510 and 25018. Ts, 52-55,000 psi; ys, 34-36,500; elong in 2 in., 12.5 to 20%; impact str (Charpy), 16.5 (.074 depth notch); endurance limit, 30,000-31,800 psi; bhn, 110-145; sp gr, 7.32; resists corrosion caused by atmosphere, moisture or water and smoke; max cont serv temp, 800 F. Resists shock and/or impact which may distort the casting but only under the most severe cases will it fail completely. For use in any machine, automotive transportation equipment, electrical fittings, and other applications which require castings in considerable quantities having a maximum dimension of 40 in.; practical metal thickness 3/32-in. except in very small castings where sections may be lighter.

SHOOK Alloy 664 (Copper-tin-zinc alloy) — Shook Bronze Corp., Lima, O.

Cu 80-83, Sn 7-9, Pb 7-9, Zn 1-2, P 0.75 and Ni 1 max; furnished in finished rods or bars and as sand castings; for machining. Comp str, 35,000 psi; ys, 22,000 psi; elong in 2 in. 20%. For bushings, bearings, gland nuts, gears, etc.

SICROMO (Alloy steels)—Timken Steel & Tube Div., The Timken Roller Bearing Co., Canton, Ohio.

Type 1; C 0.15 max, Mn 0.5 max, P 0.03 max, S.03 max, Si 1-1.4, Cr 0.75-1.25, Mo 0.45-0.65; furnished in rough bars, or billets, finished rods or bars, and tubing, for hot forging, welding, turning, boring, etc. Material is corrosion resistant to 1050 F; ts, 60,000 psi min; fair weldability; bhn, annealed, 163 max. For use in oil refinery field.

Type 2; similar to above with slightly higher chromium content.

Type 2½; similar to Type 2 with slightly lower silicon content.

Type 3; similar to Type 2½, with slightly higher silicon and chromium content.

Type 5; similar to Type 3, with lower silicon content and higher chromium.

Type 5S; similar to Type 5, differing only in higher silicon content.

Type 7; similar to Type 5S, having lower silicon and higher chromium content.

Type 7M; similar to Type 7, but having an increased molybdenum content.

Type 9; similar to Type 7, having higher chrominum content. All above materials are for oil refinery use.

Type 9M; similar to Type 9, but having an increased molybdenum content.

SILASTIC (Rubbers)—Dow Corning Corp., Midland, Mich.

Silicone rubbers furnished in stocks designed for coating, molding, extruding, laminating and friction calendering. Medium abrasion resistance; good resistance to oil, aqueous, neutral ammonical reagents and concentrated sodium hydroxide. Some stocks resistant to strong acids except concentrated sulfuric. Max cont, serv, temp, 300-350 F; brittle points, —70 to —180 F; flame-resistant; flexibility, high; dielectric strength, 500-1100 volts per mil depending on grade; ts, 400-700 psi; low moisture absorption; available in red and white; sp gr, 1.3-2.3 depending on grade; opaque. Has high oxidation resistance. For gaskets, diaphragms, seals, packings, tubing, mountings, wire insulation, and weather resistant rubber parts.

SILENTBLOC (Composite rubber-metal material)—The General Tire & Rubber Co., Mechanical Goods Div., Wabash, Ind.

Natural and synthetic rubber combined with metal. Used for mountings, bearings, couplings, motor and machine mounts to control vibration and cushion shock loads; lubrication-less oscillating or torque joints; and bushings to correct misalignment in bearings, hinges and shaft supports.

SIL-FOS (Welding rod) — Handy & Harman, New York 7.

Brazing alloy containing Ag 15, Cu 80, P 5; flows at 1300 F; furnished in rods, wire, sheets and strips (coiled). Corrosion-resistant; high ductility; sp gr, 8.45. Used to join nonferrous metals only, particularly copper brass and bronze.

SILMAN (Chisel steel) — Vanadium Alloys Steel Co., Anchor Drawn Steel Co., Colonial Steel Div., Latrobe, Pa.

C 0.55, Si 2.10, Mn 0.85, Cr 0.25 V 0.28. Furnished in rough bars or billets, finished rods or bars, wire, sheet, plate, forgings and drill rod; for permanent mold castings, precision castings, machining, hot and cold working, stamping, drawing and brazing. In heat-treated state: Hardness rockwell C. 62-63 max; magnetic; abrasion resistance, medium. For shanks, chisels dogs, shears, etc.

SILMANAL (Magnet material)—General Electric Co., Chemical Dept., Pittsfield, Mass.

Has high intrinsic coercive force, suitable for use in instrument where service in strong electrical fields is required. Ductile and malleable; can be punched, machined, rolled, or ground. Can be made in rod, strip or wire form.

SILMO (Alloy steel)—The Timken Steel & Tube Div., The Timken Roller Bearing Co., Canton, Ohio.

C 0.15 max, Mn 0.5 max, P 0.4 max, S 0.045 max, Si 1.15-1.65, and Mo 0.45-0.65; furnished in rough bars or billets, finished rods or bars, and tubing, for hot forging, welding, turning, boring, etc., into parts. Ts, 55,000 psi, min; resists heat to 1000 F; fair weldability; bhn, annealed, 163 max. For use in refinery field.

SILVERCOTE (Wire)—Little Falls Alloys, Inc., Paterson 1, N. J.

Wire of various nonferrous alloys such as beryllium copper, phosphor bronze, brass, aluminum, silverplated copper. Used for springs, wire forms, electronic parts, etc.

SILVER STAR (Spring steel)—Bethlehem Steel Co., Bethlehem, Pa.

High-carbon, high-manganese wire for coil springs.

SILVERY MAYARI (Pig iron)—Bethlehem Steel Co., Bethlehem, Pa.

High-silicon alloy pig iron made directly from nickel-chromium bearing ore, used in the production of quality castings.

SINTEEL (Steel and copper-steel powder metals)—American Electro Metal Corp., Yonkers, N. Y.

G; Copper-steel powder metal parts to design specifications. Ts, 50-100,000 psi; ys, 40-80,000 psi; elong in 2 in., 20-5 per cent; hardness, rockwell B 50-100; nonmagnetic; weldability, poor; abrasion resistance, medium. For high-strength precision powder metal parts.

R; Low-carbon steel powder metal parts to design specifications. Can be surface hardened by gas carburizing or cyaniding. Ts, 61,000 psi; ys, 50,000 psi; elong in 2 in., 5 per cent; hardness, rockwell B 60; abrasion resistance, medium. For cams, gears, and high strength powder metal parts requiring surface hardness up to rockwell C 55.

SIRVENE (Synthetic rubber)—Chicago Rawhide Mfg. Co., Chicago.

A series of scientifically compounded elastomers (synthetic rubbers), custom-developed to engineers' specifications and molded into mechanical pliable parts. Resistant to abrasion, oil, water, gases, air and temperature extremes. Used for sealing oils and greases, and for packings, gaskets and protective covers under unusual or difficult operating conditions.

SIRVIS (Mechanical leather)—Chicago Rawhide Mfg. Co., Chicago.

Leather, especially selected, tanned and treated for mechanical applications. Made in varying degrees of hardness or flexibility with high tensile strength and resilience. Used for protective boots, washers, gaskets, coupling and valve disks, bumpers, pads and frictions.

SKO-RESIN (Thermosetting plastics)—Skoning Corp., East Providence, R. I.

Phenol formaldehyde base, furnished in sheets, preforms, and powder for compression molding; abrasion resistance, low to high; for structural moldings, housings and other structural parts.

SMAVROC (Alloy steel forgings)—The Medart Co., St. Louis.

For rolls for steel or nonferrous mill bar straighteners.

S-M-S Alloys (Resistance welding electrodes)—S-M-S Corp., Detroit 11.

Supplied in rods and bars; for welding automobile frames and most other welded parts of automobile outside of cast-iron engine block.

SOFTWELD (Welding electrode)—Lincoln Electric Co., Cleveland.

For arc welding cast iron where a soft machinable weld is desired. Weld metal is high nickel alloy.

SOLDERALL (Solder)—L. S. Brach Mfg. Corp., Newark, N. J.

Solder in paste form comprising solder dust combined with noncorrosive dust. Used for soldering brass, copper, bronze and steel. Excellent for use in extremely fine or small work such as in radio wiring.

SORBO-MAT (Cast irons)—Sorbo-Mat Process Engineers, St. Louis.

A group of specially processed cast irons produced to meet wide variety of machine parts requirements.

SPAULDING ARMITE (Hard vulcanized fiber)—Spaulding Fibre Co., Inc., Tonawanda, N. Y.

Fish paper in sheets and rolls for stamping or forming into parts; ductile; dielectric str, 200-550 volts per mil; abrasion and corrosion-resistant; ts, 9000-15,000 psi.

SPAULDING FIBRE (Hard vulcanized fiber)—Spaulding Fibre Co., Inc., Tonawanda, N. Y.

Furnished in sheets, rods and tubes for machining, stamping or forming into parts; dielectric str, 150-400 volts per mil; ts, 9000-15,000 psi; available in colors; resistant to shock. Used for mechanical and electrical applications where toughness, light weight and machining and forming properties are essential.

SPAULDITE (Phenolic plastics)—Spaulding Fibre Co. Inc., Tonawanda, N. Y.

Phenolic base, thermosetting; furnished in laminated sheets, rods and tubes for machining or stamping into parts; dielectric str, 700 volts per mil; low moisture absorption; high polish, corrosion and heat-resistant (220 F); resistant to shock. Used for electrical insulation and where resistance to moisture and chemicals, appearance and permanence are essential.

SPAULDO (Insulation)—Spaulding Fibre Co., Inc., Tonawanda, N. Y.

Fiber material furnished in sheets and rolls for forming or stamping into parts; tear-resistant; dielectric str, 300 volts per mil; heat resistant to 220 F; high polish; corrosion-resistant; ts, 5000-16,000 psi; resistant to shock. Used for applications where flexibility and toughness in both grain directions are essential.

SPEED CASE (Free-machining steel)—Monarch Steel Co., Indianapolis, and affiliate, W. J. Holliday & Co., Hammond, Ind. Also The Fitzsimons Steel Co., Youngstown 8, O.

A low-carbon, free-machining open hearth steel (X1515) furnished in hot-rolled plate and bars, cold finished bars. Typical analysis: C 0.20, Mn 1.25, S 0.25, P 0.04 max, Si 0.07 max. Ts, 62-72,000 psi. Impact resistance at low temperatures and ductility equal to or better than SAE 1020. Machines readily, 200-250 SFPM (average). Case hardens rapidly with deep, uniform penetration. Has low hysteresis loss. Can be forged, cold-formed or rolled and welded. Widely used for gears, spindles, shafts, etc.

SPEED-TREAT (Free-machining steel) — Monarch Steel Co., Indianapolis, and affiliated company, W. J. Holliday & Co., Hammond, Ind. Also The Fitzsimons Steel Co., Youngstown 8, O.

A medium-carbon, free-machining open-hearth steel (X1545) furnished in hot-rolled plate and bars, and cold-finished bars. Typical analysis: C 0.45, Mn 1.30; P 0.04, max, S 0.25, Si 0.07 max. Ts, 90-100,000 psi. Machines 50 per cent faster than SAE 1045. Impact resistance at low temperatures and ductility equal to or better than SAE 1045. Can be satisfactorily heat-treated. Medium hardness and hardenability similar to that of SAE 1045. Can be forged and welded. Used for gears, cams, shaft pins, welded shovel dippers, etc.

SPEER (Carbon and graphite)—Speer Carbon Co., St. Marys, Pa.

Carbon, electrographite, metal-graphite materials; in finished plates, bars, rods, for further machining. Not attacked except by oxidizing chemicals; starts to oxidize at 500 C; sp gr, 2-2.20; ts, 1000-4000 psi; crushing, 2800-4500 psi. Used for contacts, bearings, molds, dies, seal rings, etc.

S-POLYMER (Thermoplastic resin)—Enjay Co, Inc., New York 19.

Modified styrene type thermoplastic resin; furnished in form of granules for injection molding, compression molding, transfer molding, casting and extruding. Abrasion resistance, high; has excellent resistance to acids, alkalis, water. Soluble in hydrocarbons and organic solvents. Max cont serv temp, 130-140 F; dielectric strength (volts per mil, inst.), 500-700; ts, up to 3000 psi; comp str, greater than 16,000 psi; generally produced white, but other colors can be produced by compounding; moisture absorption, low; sp gr, 0.93-0.96; is translucent; machinability, poor; hardness, Rockwell M, 10; very low moisture, vapor and gas permeability; internally plasticized; excellent light stability; good compatibility with waxes and other resins; good metal adhesion. Suitable for food and tobacco packaging, wax modifier, electrical insulation, laminating agent for paper, fiber binder, processing aid and reinforcer for rubbers and resins.

SPONGEX (Sponge rubber)—The Sponge Rubber Products Co., Shelton, Conn.

Furnished in sheets, strips, rods and tubes, extruded or for molding. Abrasion resistance, low; chemical resistance, excellent against many commercial chemicals and oils; max cont serv temp, 175 F; flexibility, high; ts, 25-150 psi; available in black, tan, red and other colors; opaque; shatterproof. For vibration elimination, cushioning, sealing and gasketing.

STACKPOLE (Powder metals, carbon, metal-graphite, and magnetic materials)—Stackpole Carbon Co., St. Marys, Pa.

Silver-tungsten: for contacts for circuit breakers, relays, contactors, etc.; Rockwell B, 85-90; sp gr, 11.4-15; weldability, good.

Silver-molybdenum: Furnished in parts finished to size; Rockwell B, 80; sp gr, 10.3; weldability, good. For contacts for circuit breakers, relays, contactors, etc.

Iron powders: Molded to close tolerances. Used for gears, pole pieces for small motors, magnetic yokes, iron cores, also large parts and unusual shapes where much machining is ordinarily involved.

Sintered Alnico magnets to sepcification.

STAINWELD (Welding electrodes) — Lincoln Electric Co., Cleveland.

Coated electrodes for welding stainless steels or building up surfaces to resist corrosion.

Type A-5; for large number of so-called 18-8 stainless steels. Welds are of high tensile strength and ductility and possess same resistant qualities as the parent metal. Contains suitable amount of columbium to prevent intergranular corrosion of deposited metal. AWS E-347-15.

Type A-7; for stainless steels of 18 per cent chromium, 8 per cent nickel type; fast flowing, smooth operating. Especially adapted for surfacing other steels with minimum admixture of base metal. AWS E-347-16.

Type B; for arc welding stainless steel with chemical content of approximately 25 per cent chromium and 12 per cent nickel. Physical properties equal to metal welded.

Type C; a modification of the well-known 18-8 analysis, commonly known as 18-8 SMO (approx 3½ molybdenum). Suitable for welding stainless steels of Types 316-317.

Type D; for stainless steels of 25 per cent chromium, 20 per cent nickel types; also for welding stainless steels to mild steel and for welding steels which are air-hardened and cannot be heat treated after welding. AWS E-310-15.

STANDARD ALLOY H-R (Nickel-chromium steel)—Standard Alloy Co., Inc., Cleveland, Ohio.

Low carbon, 18% chrome—8% nickel to high analysis such as 75% nickel—13% chrome; furnished in centrifugal tube castings and sand castings to specifications. Typical properties in untreated sate: Ts, 70,000 psi; ys, 30,000 psi; elong in 2 in., 4-25%; Bhn, 170 (avg); sp gr (avg), 8.3; are resistant to acids, salts and atmospheres; max cont serv temp, 1800-2000 F; abrasion resistance, high. For conveyor drums and belts, rails, drive shafts, grids, trays, roller rails, rolls, boxes and pots, rolling mill parts, gasoline and oil cracking unit parts, etc.

STANDARD (Steel tubing)—Standard Tube Co., Detroit 28.

Tubing in SAE 1010-1035 carbon steels and 18-8 stainless steel types; for cold working, drawing and resistance welding. In cold-worked state: ts, 48,000 psi; ys, 35,000 psi; elong in 2 in., 25%, hardness, Rockwell B, 60-75; weldability, good. Available in a wide variety of shapes and sizes for uses such as roller conveyors, automotive parts, vacuum cleaner handles, washing machine rolls, etc.

STEATITE (Ceramic) — General Ceramics & Steatite Corp., Keasbey, N. J.

Furnished in finished parts, rods, tubes and plates. Abrasion resistance, high; resists corrosion caused by alkalies and acids; heat resistant to 1800 F; dielectric str, 300 volts per mil; ts, 9500 psi; comp str, 81,000 psi; moisture absorption, none; produced in white; impact resistance, 2.27 psi; sp gr, 2.7; opaque. For light bearings, radio frequency insulating parts, etc.

STERLING (Insulating varnishes)—The Sterling Varnish Co., Haysville, Pa.

A complete line of insulating varnishes for all types of electrical windings.

STERLING (Stainless steels) — Firth-Sterling Steel and Carbide Corp., McKeesport, Pa.

Standard stainless steels furnished to AISI specifications. For property and application data, see "Stainless Steels" listing at end of this section.

STERMET (Stainless and heat resistant steels)—Sterling Alloys, Inc., Woburn, Mass.

Standard stainless and heat resistant steel castings in AISI types. For type, property and application data see 'Stainless Steels" listing at end of this section.

STONEWALL (Asbestos cement board)—Rubberoid Co., New York 18.

Furnished in sheets; abrasion resistance, high; max cont serv temp 450-500 F; noninflammable; flexibility, low; ts, 1900 psi; comp str, 10,000 psi; modulus of rupture, 3500 psi; moisture absorption, medium; available in natural gray, opaque; shatterproof; sp gr, 1.92. For electrical control bases, switch cells, etc.

STONEWALL (Babbitt) — United American Metals Corp., Brooklyn 22, N. Y.

Furnished in bars and pigs. In cold-worked state: Ts, 10,800 psi; comp str, 16,380 psi; ys, 8720 psi; elong in 2 in., 0.07 per cent; bhn, 24.3. For heavy-duty high-speed service.

STOODITE (Hard facing rod)—Stoody Company, Whittier, Calif.

Cast, of Cr, Mn, Zr, Si, C and Fe. Rockwell C hardness, 54-58. Used on parts subjected to sliding friction such as plowshares and steel mill guides. Polishes under abrasion, resists galling and pitting. For oxyacetylene and d-c electric application.

STOODY (Hard facing rod)—Stoody Company, Whittier, Calif.

Stoody 1: A cast hard-facing rod of Co, Cr and W. Rockwell C hardness, 54. Has high resistance to abrasion and corrosion, even at red heat. Used for hard-facing underreamer lugs, carbon scrapers, wire guides, wood saw teeth, etc. For oxyacetylene and a-c and d-c electric application.

Stoody 6: A cast hard facing rod of Co, Cr and W. Rockwell C hardness, 41-43. Has high abrasion, corrosion and impact resistance; these qualities retain at red heat; machinable with sintered carbide tools. Used for high-pressure, high-temperature valves, hot trimming dies, exhaust valves and seats, etc. For oxyacetylene and a-c and d-c electric application.

STOODY SELF-HARDENING (Hard facing rod)—Stoody Company, Whittier, Calif.

A fabricated steel hard-facing rod containing Cr, Mn, Si, Mo, C and Fe. Rockwell C hardness, 52-56. Can be forged at red heat; forms excellent bond with manganese steel; has high resistance to severe abrasion and impact. Widely used for heavy construction equipment; crusher jaws, bucket lips, grader blades, etc. For oxyacetylene and a-c and d-c electric application.

Stoody Self-Hardening 21: A fabricated steel hard-facing rod containing Cr, Mn, Si, Zr, and Fe with a Rockwell C hardness of 54-56. Deposits contain about 18% alloys. For high resistance to severe abrasion and impact encountered in heavy construction equipment, crushing equipment, manganese steel parts and the like. Bare rods give high deposition rate, a-c or d-c.

Stoody 1027: An alloy-coated hard-facing rod containing Cr, Mn, Fe and C. Rockwell C hardness, 54. Forgeable at red heat. Bonds readily with manganese steels. Possesses good wear resistance and high impact strength. Excellent weldability permits all-position welding. Used for dredge pump casings, impellers, tractor idlers and such parts as cannot be positioned.

STOODY TUBE BORIUM (Hard facing rod)—Stoody Company, Whittier, Calif.

A fabricated steel rod containing irregularly shaped particles of cast tungsten carbide in various screen sizes. Hardness is 9-10 on Moh's scale. Deposits are heterogeneous, the tungsten carbide particles being floated in the steel matrix. Used on earth working equipment, drill bits and equipment subjected to severest types of abrasion. For oxy-acetylene and d-c electric application.

STRAIN-TEMPERED (Cold finished steels)—Bliss & Laughlin Inc., Buffalo, N. Y.; Harvey, Ill.; Mansfield, Mass.

Medium and high carbon cold finished steels for high physical properties and increased ductility.

STRENES C (Gray iron)—The Advance Foundry Co., Dayton 3, O.

Alloyed high-strength gray iron furnished in sand castings. In untreated state: Ts averages 50,000 psi; Bhn, 220; and Charpy impact str, 70 ft-lb. Has fair weldability, medium abrasion resistance. Max cont. serv. temp, 1500 F. Used for cast stamping, forming and drawing dies, jigs, fixtures, die rings, cylinders, and all wearing surfaces as in machine tools.

STRESSPROOF (Manganese steel) — La Salle Steel Co., Hammond, Ind.

A severely cold-worked furnace-treated carbon steel bar; C 0.40-0.48, Mn 1.35-1.65, P 0.045 max, S 0.24-0.33, Si 0.10-0.25; furnished in finished bars for machining. Ys, 100,000 psi min in sizes ⅝-in. to 2 in. and 90,000 psi min. in sizes over 2 in. through 3¼ in. Machines approximately 125 sfpm. Requires no heat treating but has replaced carbon and alloy carburizing steels. Available both cold drawn and ground and polished. Used for worm gears, lead screws, spindles, shafts, etc.

STRONG #18 (Steel castings)—Strong Steel Foundry Co., Buffalo 7.

C 0.3-0.35, Mn 0.9-1.1, Si 0.25-0.35, P and S under 0.05. Normalized at 1650 F and drawn at 1250 F, properties are: Ts, 80,000 psi; ys, 40,000 psi; elong in 2 in., 20%; bhn, 160-180; machinability, good; weldability, good; abrasion resistance, medium. Is generally used for large gears.

STUPAKOFF (Ceramic)—Stupakoff Ceramic & Mfg. Co., Latrobe, Pa.

No. 621; Seattle ceramic furnished in finished form made by molding, casting, machining, stamping, extruding. Abrasion resistance, high; resists corrosion caused by acids and alkalies, except hydrofluoric acid; dielectric str, 200 volts per mil inst; ts, 9000 psi; comp str, 75,000; moisture absorption, low; available with colored glaze; sp gr, 2.6; opaque. For electrical insulating parts.

No. 1100; ceramic furnished in rods and tubes. Abrasion resistance, high; chemical resistance, good; max cont serv temp 1800 F; noninflammable; flexibility, low, 7000 psi; comp str, 70,000 psi; flexural str, 18,000 psi; available in white to cream colors; opaque; shatterproof; sp gr, 2.56. For use in radio and high-frequency applications.

STYRON (Dow polystyrene plastics)—The Dow Chemical Co., Midland, Mich.

Thermoplastic; furnished in granules for molding; high clarity; low specific gravity; corrosion-resistant; dielectric strength, 5000 volts per mil at 1 mil, 500 volts per mil at 125 mil; ts, ult, to 10,000 psi; low moisture absorption; low inflammability; available in color; transparent. Used for insulators, decorative articles, structural parts, general injection molding, etc.

SUMET (High leaded bronzes)—Sumet Corp., Buffalo.

SM-8; Pb 24-27 per cent. For moderate speed and general service; suitable for machine tool bearings.

SM-10; Pb 22-25 per cent. For general applications such as aeronautical engines, clutch cones and disks, compressors, connecting rods, crank pins, etc.

SM-12; Pb 20-23 per cent. For cone and gyratory crushers, crane and ore machinery, mining machinery, etc.

SM-14; Pb 12-15 per cent. For thrust bearings, gears, etc.

SM-16; Pb 19-21 per cent. For heavy-duty service such as crane motor compressor, dredging machinery, etc.

SM-18; Pb 16.5-18.5 per cent. For crosshead pins, cranes, railroad, steam shovels, etc.

SUMMERILL (Seamless tubing) — Summerill Tubing Co., Carnegie, Pa.

Seamless tubing in practically all regularly used carbon grades from SAE 1010 to SAE 1095. Others are chrome molybdenum SAE 4130X, 4140, 4150, 4185, 52100, 4340, NE-8630, NE-8635, nickel-silver, pure nickel-silver, corrosion-resistant steels—18-8, 16-13-3 and similar grades; 4 to 6 per cent chrome with ½ moly; also some of 12-14 per cent chrome, beryllium copper, K-Monel and Invar. Available in any shape, and in sizes ranging from 0.012-in. to 5½ in. OD. Used for mechanical specialties, aircraft, industrial control instruments, fuel injection tubing for diesel engines, etc.

Also tapered and formed tubes for many special parts.

SUPERGRAPH (Carbon, graphite, and metal-graphite)—Superior Carbon Products, Inc., Cleveland, O.

Furnished in round and rectangular shapes and finished parts. For bearings, valve seats, brushes, seal rings, etc.

SUPERIOR No. 3 (High alloy steel)—Braeburn Alloy Steel Corp., Braeburn, Pa.

Alloy steel having C 1.50, Cr 12.00, V 0.85, Mo 0.80; furnished in rough bars or billets and finished rods or bars, for machining. In heat-treated state: comp str, 550,000 psi; hardness, Rockwell C, 56-62. For forming rolls, lathe and grinder centers, etc.

SUPERIOR (Chrome-plated steel strip)—Superior Metal Co., Chicago 38.

Corrosion-resistant strip chrome-nickel-plated and finished bright on one side, satin finished on other side. Furnished in coiled or straight strip for stamping. In cold-worked state: resists heat to 750 F; resists corrosion caused by moisture; magnetic; max cont. serv. temp. 250 F. For any mildly drawn part requiring chrome plating.

SUPERIOR (Magnesium base alloy) — Superior Bearing Bronze Co. Inc., Magnesium Div., Brooklyn 22.

Magnesium castings for specific requirements.

SUPERIOR (Metal tubing)—Superior Tube Co., Norristown, Pa.

Carbon steels: AISI MT C-1008,, 1010, 1015, 1020, 1025, 1035, 1075 and 1095.

Alloy steels: AISI MT 4130, 4155 and 52100.

Stainless steels: Seamless and Weldrawn AISI types 303, 304, 316, 317, 321, 347, 403, 420, 430, 446 and 502 (T-1).

Nickel alloys: Seamless and Weldrawn "A-Nickel," Monel, "K-Monel," Inconel and 30% cupro-nickel.

Specialties: Invar (36% nickel-iron), 42% and 52% nickel-iron, 27% chrome stainless, 18-12 stainless, 18% nickel silver, seamless and Weldrawn beryllium copper. Electronic cathode and anode parts; diesel high and low-pressure fuel-injection tubing, special pressure and hydraulic tubing.

Above available in all shapes, in sizes ranging from 0.010 to ⅝-in. OD in the round. Sizes to 1⅛-in. OD x 0.042-in. wall maximum in special analyses. Specializing in tubing drawn to all applicable AMS, ASTM, Army and Navy specifications.

SUPERIOR (Seamless brass and copper tubing)—Penn Brass & Copper Co., Erie, Pa.

From 5/32-in. OD x 0.010-in. wall, to and including 1-in. OD x 0.072-in. wall; both in copper of pure electrolytic mixture and in brass of 3 alloys, namely; 70/30, 2-1 leaded, and 85/15.

Furnished to the following ASTM specifications:

Copper: B 68-47, Bright annealed
B 75-47T, General-purpose
B 188-47T, Electric conductors
Brass: B 135-47T, Alloy 85/15, 20/30, 66/33 leaded.

SUPERIOR (Stainless strip steel) — Superior Steel Corp., Carnegie, Pa.

Hot and cold-rolled strip stainless steels in all standard grades and analyses. For data on type, properties, characteristics, and applications see "Stainless Steels" listing at end of this section.

SUPERMAL (Malleable iron castings)—The Jeffrey Mfg. Co., Columbus 16, O.

C 1.60-1.80, Mn 0.20-0.40, Si 0.90-1.10, heat treated; ts, 60-70,000 psi; ys, 50-60,000 psi; elong in 2 in., 8 to 6%; bhn, 179-201. For chain links, buckets, conveyor equipment, etc.

SUPER Y (Alloy malleable castings) -- Chicago Malleable Castings Co., 1225 West 120th St., Chicago 43, Ill.

Regular white iron with 1% Cu, and 0.30% Mo added. In normal annealed state, as, 60,000 psi; ys, 40,000 psi; elong in 2 in., 16%; Bhn, 143.

SURCO AMERICAN (Thermosetting plastics)—Suprenant Electrical Insulation Co., Ben, Mass.

Furnished in sheets, rods or tubes; for molding, stamping and extruding. Abrasion resistance as required; resists corrosion caused by acids and other corrosion elements; heat resistant to the degree required; flexibility as required; dielectric str, 1500 volts per mil avg; ts, 200-4500 psi; moisture absorption, low; available in 26 colors; shatter-proof; sp gr, .90-1.45; opaque; machinability, good. For control cables, etc. in machine tools.

SUVENEER (Clad steel)—Superior Steel Corp., Carnegie, Pa.

Steel clad on one or both sides with stainless, nickel, Monel, copper, and some copper-base alloys, etc; furnished in strips; for stamping, welding, deep drawing, rolling, spinning, soldering, etc.

SWEET HOME BRAND (Resin-bonded plywood)—Oregon Plywood Corp., Sweet Home, Oregon.

Phenolic resin-bonded, thermosetting fir plywood; moisture and water resistant. Used for aircraft cabinets, instrument panels, bases, bodies, boxes, etc.

SYNFLEX (Rubber-like synthetics) — Industrial Synthetics Corp., Garwood, N. J.

Polyvinyl chloride and polyvinyl copolymers; thermoplastics; in rods, tubes, shapes and tapes. Abrasion resistance, high; resists corrosion caused by weak and strong inorganic acids, sulphuric acids and alkalies; heat resistant to 230 F; flexibility, high; dielectric strength to 3600 volts per mil, ts, to 3600 psi; moisture absorption, low; shatterproof; sp gr, 1.18-1.48; transparent, translucent and opaque. Four outstanding compounds as well as special compounds for specific applications are available, such as window channel, mechanical rubber goods, electrical insulation, communications, etc.

SYNTHANE (Phenolic laminated plastics)—Synthane Corp., Oaks, Pa.

Thermosetting, corrosion resisting; furnished in sheets, rods and tubes, fabricated parts, and in parts made by molding the impregnated base materials. Available in following grades:

X; Kraft paper base, hard resin, laminated material; for mechanical applications where electrical requirements are of secondary importance; ts, 12,500 psi.

XP; Kraft paper base; plasticized resin, laminated material, primarily intended for punching; more flexible and not quite as strong as Grade X; moisture resistance and electrical properties intermediate between Grades X and XX.

XX; cotton rag paper base laminated material; hard, greater percentage of resin than Grade X. Suitable for usual electrical applications; good machinability.

XXP; cotton rag paper base laminated material; similar to Grade XX in electrical and moisture-resisting properties, but more suitable for hot punching. Intermediate between Grades XP and XX in punching and cold flow characteristics.

XXX; cotton rag paper base laminated material; suitable for radio frequency work, for high humidity applications, minimum cold flow characteristics.

XXXP; cotton rag paper base laminated material; similar to Grade XXX but with lower dielectric losses and more suitable for hot punching; greater cold flow than Grade XXX, and intermediate between Grade XXP and XXX in punching characteristics.

C; heavy weave fabric; base laminated material made throughout from cotton fabric weighing over 4 oz per sq yd, and having a count of not more than 72 threads per in. in the filler direction, nor more than 140 threads per in. total in both warp and filler direction. Strong, tough material suitable for gears and other applications requiring high impact strength. Available in subgrades, depending upon sizes of gears and types of mechanical service. Should not be used for electrical applications.

CE; heavy weave fabric base laminated material, same as Grade C. For electrical applications requiring greater toughness than Grade XX, or mechanical applications requiring greater resistance to moisture than Grade C.

L; fine weave fabric base laminated material, of cotton; suitable for small gears and other fine machining applications, particularly in thickness under ½-in. Not quite as tough as Grade C; should not be used for electrical applications except for low voltage.

LE; fine weave fabric base laminated material, same as Grade L; for electrical applications requiring greater toughness than Grade XX; better machining properties and finer appearance than Grade CE. Also available in thinner sizes. Exceptionally good in moisture resistance.

SYNTHOLVAR (Thermoplastic plastics)—Varflex Corp., Rome, N. Y.

Vinyl chloride acetate type furnished in form of tubes; abrasion resistance, high; dielectric strength (volts per mil inst.), 700-1000; ts, 2500-3000 psi; moisture absorption, low; available transparent and opaque; hardness, Shore Durometer, 80-85. Used as insulation by manufacturers of many types of electrical equipment.

SYROCOWOOD (Molded wood)—Syracuse Ornamental Co. Inc., Syracuse, N. Y.

Thermosetting and thermoplastic; furnished as molded parts. Abrasion resistance, low; flexibility, low; opaque. For nameplates or decorative parts, also for radio type control knobs.

T

TALIDE (Tungsten carbide) — Metal Carbides Corp., Youngstown, O.

Furnished in rough bars or billets, finished rods or bars, tubing, permanent mold castings, and powder metals. Is self-hardening during processing; heat treated, ts, 300,000 psi; comp str, 750,000 psi; impact strength (Charpy), 1.10; hardness, Rockwell C, 90-92; sp gr, 14.60; is nonmagnetic; weldability, good; resists most acids and chemicals; max cont serv temp, 2000 F; abrasion resistance, high. Maintains cutting edge while red hot. Used for cutting tools, drawing dies, drill jig bushings, lathe and grinder centers, centerless grinder blades, sand blast nozzles, guides, wear-resistant plates, etc.

TAMCO (Rimming steel)—Titanium Alloy Mfg. Co., Niagara Falls, N. Y.

Alloys including original high and medium-carbon ferro carbon-titanium, foundry ferro titanium, and several varieties of low-carbon ferro-titanium for rolled, cast and forged steels, stainless and alloy steels, and gray cast iron.

TANTUNG (Nonferrous casting alloy)—Vascoloy-Ramet Corp., Waukegan, Ill.

Co 45-50, Cr 37-32, W 14-19, C 2-4, Ta 2-7, Mn 1-3, and Fe 2-5. Fabricated by sand castings, permanent-mold castings, and precision castings. No heat treatment required. Ts, 65,000 psi; hardness, 53-63 Rockwell C; transverse rupture str, 320,000 psi; nonmagnetic; machinability, poor; weldability, poor; max cont serv temp, to 1600 F; resists corrosion caused by fruit and vegetable acids, nitric acid, phosphoric acid, sodium carbonate, hot dilute KOH; abrasion resistance, very high. Used for bearings, bushings, compression springs, burner plates, homogenizing valves, wire guides, turbine blades, pump gears, extrusion nozzles, gripper blocks, wire twister gears, valve seats, thread guides, cutters, shredding knives, etc.

TAYLOR FIBRE (Phenolic laminated plastics)—Taylor Fibre Co., Norristown, Pa.

Thermosetting; furnished in laminated sheets, rods and strips for machining into parts. Abrasion resistance, medium and high; chemically resistant to most common solvents; max cont serv temp, 200 F; noninflammable; flexibility, high; dielectric str, 300 volts per mil; ts, 7500 psi; comp str, 25,000 psi; flex str, 13,000 psi; available in red, gray, black and white; shatterproof; sp gr, 1.25; opaque; bhn, 25. Used for electrical insulation and wherever high arc resistance is required.

Grade C-5; Canvas-base, melamine formaldehyde; furnished in sheet and plate. Has good resistance to weak acids and most organic solvents; max cont serv temp, 275 F; flexibility, low; ts, 8000 psi; comp str, 38,000 psi; flex str, 16,000 psi; moisture absorption, low; produced in natural and white colors; is shatterproof; sp gr, 1.4; is opaque; hardness, Rockwell M109. This is a plating barrel stock having high arc resistance and high acid chemical resistance.

TAYLOR PHENOL FIBRE (Laminated phenolic plastics)—Taylor Fibre Co., Norristown, Pa.

Grade C: Furnished in sheet, strip, rods or tubes; abrasion resistance, high; resists caustic solutions to 2% concentration, acid solutions to 10% concentration and common solvents; max cont serv temp, 200 F; is slow burning; flexibility, low; dielectric strength (volts per mil inst.), 200; ts, 7500 psi; comp str 38,000 psi; elong, 2%; moisture absorption, low; produced in natural and black; has high impact strength; sp gr, 1.36; is opaque; machinability, good; hardness, Rockwell M-108. For gears, cams, structural parts, etc.

Grade XX: Sheets, tubes and rods; abrasion resistance, high; resists caustics up to 1% concentration; acids up to 5-10% concentration and common solvents; max cont serv temp, 225 F; is slow burning; flexibility, low; dielectric strength, $\frac{1}{16}$ in. thick, (volts per mil inst.), 500; ts, 9000 psi; comp str, 34,000 psi; transverse str, 16,000 psi; elong, 1%; moisture absorption, low; produced in natural and black; has medium shock resistance; sp gr, 1.36; is opaque; machinability, good; hardness, Rockwell M, 110. For terminal blocks, panels, washers, coil forms, etc.

Grade XP: Furnished in sheets and rods; abrasion resistance, medium; is not recommended for chemical application; max cont serv temp, 225 F; flex str (ASTM D 650-42-T) 15,000 psi; dielectric str, $\frac{1}{16}$ in. thick (volts per mil inst.), 500; ts, 8000 psi; comp str, 22,000 psi; produced in natural and black; moisture absorption, low; sp gr, 1.36; is opaque; machinability, good; bhn, 30. For washers, punchings, etc.

Grade G-5: Furnished in laminated sheets, rods and tubes; abrasion resistance, medium; resists caustic concentration 1%, acid concentration 10-20%, and common solvents; max cont serv temp, 350 F; flex str (ASTM D 650-42T), 40,000 psi; dielectric str, $\frac{1}{16}$ in. thick (volts per mil inst.), 300; ts, 35,000 psi; comp str, 80,000 psi; produced in natural gray color; moisture absorption, low; sp gr, 1.95; is opaque; machinability, fair; bhn, 40. Has high temperature and arc resistance. For panel boards, structural parts, etc.

Grade XXXP: Furnished in sheets, strips and plates; abrasion resistance, medium; resists caustic concentration 1%, acid concentration 5-10%; and common solvents; max cont serv temp, 225 F; is slow burning; flexibility, low; dielectric strength $\frac{1}{16}$-in. thick (volts per mil inst.), 500; ts, 7000 psi; comp str, 25,000 psi; elong, 1%; moisture absorption, low; produced in natural and black; is not shatterproof; sp gr, 1.30; is opaque;

machinability, good; hardness, Rockwell M, 95-100. For switch bases, stators, condenser bases, etc.

Grade LE: Furnished in laminated sheets, rods and tubes; has fine weave fabric base; abrasion resistance, high; resists caustic concentration to 2%, acid concentration to 10%, and common solvents. Max cont serv temp, 200 F; flex str (ASTM D 650-42T), 15,000 psi; dielectric strength, $\frac{1}{8}$ in. thick (volts per mil inst.), 400; ts, 8500 psi; comp str, 37,000 psi; produced in natural and black; moisture absorption, low; sp gr, 1.36; is opaque; machinability, good; bhn, 36. For gears, cams, structural parts, etc.

Grade XXX: Furnished in laminated sheets and rods; has good resistance to most organic solvents; max cont serv temp, 280 F; flex str, 15,000 psi (ASTM D 650); dielectric str, 240-900 volts per mil inst., depending on thickness; ts, 7000 psi; comp str, 32,000 psi; produced in natural color and black; moisture absorption, low; sp gr, 1.34; is opaque; machinability, good; hardness, Rockwell M 100. Used for switch bases, panels, high humidity applications, etc.

Grade XXP: Furnished in laminated sheets. Has good resistance to most organic solvents; max cont serv temp, 225 F; flex str, 16,000 psi (ASTM D 650); dielectric str, 250-950 volts per mil inst. Depending on thickness; ts, 8000 psi; comp str, 25,000 psi; impact str (Izod), 0.40 ft-lb edgewise; produced in natural, black and chocolate colors; moisture absorption, low; sp gr, 1.35; is opaque; machinability, good; hardness, Rockwell M95. For washers, condensers and switch rotor and stator insulation, etc.

Grade L: Linen base; furnished in sheet, rod, tube and plate. Abrasion resistance, high; has good resistance to most organic solvents; max cont serv temp, 280 F; dielectric str, 5-250 volts per mil, inst., depending on thickness; ts, 9000 psi; comp str, 35,000 psi; flex str, 20,000; sp gr, 1.35; is opaque; machinability, good; hardness, Rockwell M97. For fine-pitch small gears, cams, knobs, etc.

Grade A: Asbestos paper-base phenolic laminate; furnished in sheets, rods, tubes and plate. Has good resistance to weak acids and to most organic solvents; max cont serv temp, 290 F; flexibility, low; dielectric str, 50-225 volts per mil, inst., depending on thickness; ts, 8000 psi; comp str, 36,000 psi; flex str, 16,000 psi; moisture absorption, low; produced only in natural color; sp gr, 1.38; is opaque; machinability, fair; hardness, Rockwell M108. For armature slot insulation and various electrical appliance insulation.

Grade X: Furnished in laminated sheet, rods and tubes. Max cont serv temp, 270 F; flex str, 23,000 psi; dielectric str, 250-950 volts per mil, inst., depending on thickness; ts, 14,000 psi; comp str, 35,000 psi; impact str (Izod), 1.3 ft-lb flat, 0.50 ft-lb edgewise; produced in natural, black and chocolate colors; moisture absorption, high; sp gr, 1.34; is opaque; machinability, good; hardness, Rockwell M103. Has excellent electrical properties. For insulating washers, bushings, coil forms, terminal boards, structural parts, etc.

Grade AA: Asbestos fabric, phenolic resin base; furnished in sheet, rods, tubes and plate. Has good resistance to weak acids and most organic solvents; max cont serv temp, 290 F; flexibility, low; dielectric str, 50 volts per mil, inst.; ts, 10,000 psi; comp str, 38,000 psi; flex str, 20,000 psi; moisture absorption, low; produced in natural color only; is shatterproof; sp gr, 1.38; is opaque; machinability, fair; hardness, Rockwell M110. Has good dimensional stability. Used for armature wedges and rotor vanes.

Grade CE: Furnished in laminated sheets, rods and tubes. Abrasion resistance, low; has good resistance to most organic solvents; max cont serv temp, 275 F; flex str, 17,000 psi (ASTM D 650); dielectric str, 100-500 volts per mil, inst., depending on thickness; ts, 8000 psi; comp str, 36,000 psi; impact str (Izod), 2.3 ft-lb flat, 1.3 ft-lb edgewise; produced in the colors natural and black; moisture absorption, low; sp gr, 1.35; is opaque; machinability, good; hardness, Rockwell M105. For small gears, pinions, switchboard panels, circuit breaker and switch arms, etc.

TEFLON (Thermoplastic plastics) — E. I. du Pont de Nemours & Co. Inc., Plastics Dept., Arlington, N. J.

A tetrafluoroethylene polymer, furnished in sheets, rods, tubes, powder and tape. Formed into machine parts by a special molding technique, by extruding and by machining. Abrasion resistance, medium; chemically resistant to anything except molten alkali metals; max cont serv temp, 550 F; dielectric str, 480 volts per mil inst; ts, 1800 psi; impact str (Izod), 2.5-4.5 ft-lb; produced in natural (gray-white) and limited special colors; moisture absorption, low; sp gr, 2.1-2.3; produced translucent and opaque; machinability, good; hardness, Durometer (ASTM D676-44T), D55; coef of thermal expansion, 9.9 x 10^{-5} in/in/deg. C. Offers outstanding combination of chemical resistance, electrical properties and high service temperature. Also has unusually nonadherent surface. Used for chemical gaskets, mechanical seals, high-temperature, high-frequency insulation, nonadherent surfaces for food machinery, chemical equipment, etc.

TEGIT (Cold-molded plastics) — Garfield Mfg. Co., Garfield, N. J.

Tan colored, cold-molded plastics; corrosion resistant; high dielectric strength; moisture absorption, less than 1%; heat resistance, 300 F; impact-resistant; resists hot oil, boiling water and ordinary chemicals; will not shrink, crack, warp or deteriorate with age. Used for heavy-duty wiring devices and small insulated parts.

TEGO (Plastics resins) — Resinous Products & Chemical Co., Philadelphia 5.

Synthetic resin adhesive, phenolic resin film, dry sheet. Has low moisture absorption, high density. Used in manufacture of water-proof plywood for aircraft and marine use.

TELNIC BRONZE—Chase Brass & Copper Co., Waterbury 91, Conn.

Cu 98.3, Ni 1.0, P 0.2, Te 0.5. A hard high-strength forgeable, age-hardenable, machinable bronze for general engineering structural uses.

TEMDCO (Hard surfacing electrode)—The MacDonald Co. Inc., Reno, Nev.

Seven types of hard surfacing electrodes, hardnesses ranging from 20 C to 63 C Rockwell.

TEMPALOY (Copper-aluminum-nickel alloy) — American Brass Co., Waterbury, Conn.

Alloys which respond to heat treatment; abrasion resistant. Uses include motorboat shafting, piston rods, bearing applications, etc.

TENITE (Thermoplastic plastics) — Tennessee Eastman Corp., Kingsport, Tenn.

Tenite I: Cellulose-acetate base, thermoplastic; furnished in granular and pellet form; available in clear transparent and colors, plain, variegated, translucent and opaque; high impact strength; high polish. Used for injection molding decorative and industrial products, also extruded in form of strips, rods and tubes.

Tenite II: Cellulose acetate butyrate base, thermoplastic; furnished in granular and pellet form; has greater dimensional stability than cellulose acetate plastic because of lower moisture absorption; contains less plasticizer than cellulose acetate plastic and the plasticizer used has greater retentivity; available in clear transparent and colors; plain, variegated, translucent and opaque; high impact strength; high polish. Used for injection molding of decorative and industrial products, also extruded in form of strips, rods and tubes.

TENSILASTIC (Rubber and rubber synthetics)—American Wringer Co. Inc., Woonsocket, R. I.

Hard and soft rubber and rubber synthetics for rolls and linings and covering of tank parts, etc. Available in any size from $\frac{1}{2}$-in. long and $\frac{1}{2}$-in. in diam to 300 in. long and 44 in. in diam; any density from dead hard to very soft; compounded to meet mechanical and chemical requirements; heat resistant to 180 F; flexibility, high; moisture absorption, low.

TERNALLOY (Aluminum alloys)—Apex Smelting Co., Cleveland 5, and Chicago 12.

No. 6; nominal composition; Mg 1.8, Zn 3.6, Mn 0.4, Cr 0.3; furnished in ingots for sand, permanent-mold, precision castings. Typical properties, as-cast, ts, 35-38,000 psi; ys, 20-23,000 psi; elong, 4-12%; Bhn, 70-75; sp gr, 2.76; nonmagnetic; weldability, good. For use where high strength, ductility, dimensional stability, and good machinability are required. Used primarily in the as-cast condition.

No. 7; nominal composition; Mg 2.1, Zn 4.2, Mn 0.4, Cr 0.3; furnished in ingots for sand, permanent-mold, and precision castings. Typical properties, as-cast; ts, 36-41,000 psi; ys, 23-26,000 psi; elong, 3-10%; Bhn, 75-90; sp gr, 2.76; nonmagnetic; weldability, good. For use where high strength, ductility, dimensional stability, and good machinability are required.

No. 8; nominal composition; Mg 2.4, Zn 4.6, Mn 0.4, Cr 0.3; furnished in ingots for sand, permanent-mold, and precision castings. Typical mechanical properties, heat treated for permanent-mold castings, ts, 58,000 psi; ys, 52,000 psi; elong, 3.0%; Bhn, 110; sp gr, 2.78; nonmagnetic, weldability, good. For use where high strength, ductility, dimensional stability, and good machinability are required.

TERRATEX (Insulating paper)—General Electric Co., Pittsfield, Mass.

Asbestos paper made with clay binder for high voltage insulation. Available in extremely thin sheets; treated with resin varnish for uses where high strength is needed. Retains tensile strength at 175 C. Noninflammable. Dielectric strength of 3-mil sheet at room temperature, 600 volts per mil. Used for coil wire insulation in transformers, motors, etc.

TESCO (Electric steel castings) — Tonawanda Electric Steel Casting Corp., North Tonawanda, N. Y.

Grade B cast steel, low carbon; furnished in sand castings to specification; ts, 70,000 psi (min); ys, 36,000 psi (min); elong in 2 in., 24%.

TETON (Carbon-chrome tool steel) — Allegheny Ludlum Steel Corp., Brackenridge, Pa.

A 1.00-carbon 1.25-chrome tool steel that is rather deep hardening and develops high compressive strength. Used for hardened machine parts subject to wear without severe shock. Usually hardened in oil.

TEXFOAM (Foam rubber)—The Sponge Rubber Products Co., Shelton, Conn.

Furnished in sheet, strip and forms molded to specification. Abrasion resistance, low; has poor resistance to oils; max cont serv temp, 150 F; is inflammable; flexibility, high; moisture absorption, high; produced in the color gray; sp gr, 0.08-0.16; is opaque; machinability, poor. Used for seat cushions, back rests, mattresses, upholstery and vibration cushioning.

TEXRUB (Rubber-like vinyl base material)—M. B. Price Associates, New York.

Rubber-like vinyl-base, thermosetting and thermoplastic materials, furnished in laminated sheets, rods or tubes; for molding, casting, machining, stamping and extruding into parts; abrasion resistance, high; resist corrosion caused by water, gas, oils, alkalies, uric acid and 30% sulphuric acid and ozone; soften at 240 F; melt at 330; flexibility, good; ts, 2500 psi. Available in black, white, gray, red, brown and green; translucent and opaque; shatterproof; sp gr, 1.26. Used for chemical tubing and piping, etc.

THERMALLOY (Alloy cast steels)—Electro-Alloys Div., American Brake Shoe Co., Elyria, O.

Grade 85: heat-resistant alloy furnished as sand castings to specification; Ni 64-70, Cr 17-20, Si 1-2, Mn 0.75-1.25, C 0.45-0.65. Nonmagnetic; weldability, fair to good; resists corrosion by hot gases, except those high in sulphur; max cont serv temp, 2000 F. For heat treating boxes and trays, retorts, enameling furnace supports, furnace conveyor parts, burner parts, etc.

Grade 72: heat-resistant alloy furnished as sand castings to specification; C 0.45-0.65, Mn 0.75-1.25, Si 1-2, Cr 12-15, Ni 58-64. In untreated condition: Ts is 62-80,000 psi; ys, 30-40,000 psi; elong in 2 in., 15-3%; bhn, 170-210; nonmagnetic; weldability, fair to good; resists corrosion by hot gases, except those high in sulphur; max cont serv

temp, 2000 F. For general furnace parts, heat treating boxes and trays, retorts, enameling furnace supports, furnace conveyor parts, burner parts, etc.

Grade 50: heat-resistant alloy furnished as sand castings to specification; C 0.45-0.65, Mn 0.75-1.25, Si 1-2, Cr 15-18; Ni 34-37. Ts, 55-75,000 psi; ys, 32-55,000 psi; elong in 2 in., 20-4%; bhn, 150-195; nonmagnetic; weldability, fair to good; resists corrosion by hot gases except those high in sulphur; max cont serv temp, 2000 F. Used for furnace retorts, heat treating and carburizing boxes, burner parts, conveyor chain, furnace supports, etc.

Grade 40: heat-resistant alloy furnished as sand castings to specification; C 0.3-0.4, Mn 0.75-1.25, Si 1-1.75, Cr 26-28, Ni 10-13. Ts (untreated), 65-95,000 psi; ys, 36-55,000 psi; elong in 2 in., 30-4%; bhn, 170-260; nonmagnetic or weakly magnetic; weldability, good; resists corrosion by hot gases; max cont serv temp, 2000 F. For shafts, disks, beams, chain rollers and other heat-treating furnace parts; oil still tube supports; dampers and valves; paper-mill digester parts; burner tips and nozzles; rabble arms, and blades; furnace buggies; etc.

Grade 30: heat-resistant alloy furnished as sand castings to specification; C 0.25-0.35, Mn 0.75-1.25, Si 0.75-1.75, Cr 19-22, Ni 7.5-10. Untreated: Ts, 75-100,000 psi; ys, 40-50,000 psi; elong in 2 in., 40-20%; bhn, 170-210; nonmagnetic or weakly magnetic; weldability, good; corrosion resistant to hot gases and corrosive liquids; max cont serv temp, 1600 F. For mine water and acid pump parts, chemical mixer parts, marine fittings, oil still supports, etc.

Grade 38: heat-resistant alloy furnished as sand castings to specification: C 0.3-0.4, Mn 0.75-1.25, Si 0.75-1.75, Cr 27-30, Ni 7-10. Untreated: Ts, 85-110,000 psi; ys, 40-75,000 psi; elong in 2 in., 18-2%; bhn, 200-270; magnetic; weldability, good; resists corrosion by hot gases; max cont serv temp, 2000 F. Suitable for same type parts as Grade H.

Grade 47: heat-resistant alloy furnished as sand castings to specification: C 0.3-0.4, Mn 0.75-1.25, Si 1.25-2.25, Cr 24-27, Ni 19-22. Untreated: Ts, 65-95,000 psi; ys, 40-70,000 psi; elong in 2 in., 25-12%; bhn, 160-195; nonmagnetic; weldability, good; resists corrosion by hot gases. For general furnace parts and carburizing containers.

Grade 28: heat-resistant alloy furnished as sand castings to specification; C 0.2-0.4, Mn 0.75-1.25, Si 0.75-1.75, Cr 26-29, Ni 3.0 max. Untreated: Ts 65-95,000 psi; ys, 45-55,000 psi; elong in 2 in., 5-0%; bhn, 170-240; magnetic; weldability, fair; resists corrosion caused by hot gases. For lead pots, sintering bars, grate bars and tuyeres, roaster furnace rabble arms and blades.

THERMALLOY HC 250 (High-alloy cast steel)—Electro-Alloys Div., American Brake Shoe Co., Elyria, O.

A 26% chromium, high-carbon steel furnished in form of sand castings to specification. Is annealed for machining; heat treatment necessary for maximum hardness. In heat-treated state: Ts, 90-130,000 psi; comp str, 400,000 psi; bhn, 700-750; is magnetic; machinability, fair; weldability, poor; max cont serv temp, 1800 F; abrasion resistance, high. Used for rolls, pump parts, pug mill knives, roaster furnace blades, scrapers, conveyor wear plates, burner nozzles, molds, etc.

THERMO-CAST (Plastics tooling material)—Ernst Bischoff Co. Inc., Plastic Division, Ivoryton, Conn.

An ethyl-cellulose base thermoplastic embodying good flow characteristics at melt temperature, retention of exact mold dimensions and high degree of durability, toughness and acid resistance. Pouring temperature, 380-420 F; comp str to failure, 5000-12,000 psi; cold mold shrinkage (inch per inch), 0.001-0.006; coefficient of thermal expansion (inch per inch per degree C), 0.0005-0.0001; ts, 800-3300 psi; modulus of elasticity, 50,000-100,000 psi; flexural strength, 2000-5000 psi; water absorption, 0.22-0.35% in forty-eight hours; machinability, good; castability, excellent. Used for casting into forming blocks, drill jigs, dies and other tools.

THERMOLAIN (Ceramic)—The Star Porcelain Co., Trenton 9, N. J.

Supplied in rods and tubes and special forms. Abrasion resistance, high; chemical resistance, high; max cont serv temp, 1500 F; dielectric str, 200 volts per mil inst at 20 C; flexural str, 3100 psi; moisture absorption, medium; supplied in white and black; is not shatterproof; sp gr, 2.15; available in opaque only; machinability, poor; coef of thermal expansion, 0.0031 in./in./degree C.

THERMOPANE (Glass with metal edge seal)—Libbey-Owens-Ford Glass Co., Toledo, O.

Metal-to-glass edge-sealed with dehydrated dead-air spaces; furnished in flat units; abrasion resistance, high; resists corrosion; heat resistant to 150 F; flexibility, low; modulus of rupture, 6500 psi; noninflammable; moisture absorption, low; sp gr, 2.52; coefficient U for double-glass Thermopane with ¼-in. or ½-in. airspace approx 0.65 to 0.58; transparent and translucent. For insulated observation windows.

THERMOPLAX (Cold-molding plastics)—Cutler-Hammer Inc., Milwaukee.

Asbestos base with bituminous or phenolic type of binder; cold-molded into parts; heat resistant to 400-1000 F; noninflammable; dielectric str, 40-100 volts per mil; resistant to corrosion; takes high polish; ts, 2000-4000 psi; moisture absorption, 2 per cent. Used for electrical and heat insulation.

THINSTEEL (Carbon, alloy and stainless strip steel) — The Cold Metal Products Co., Youngstown, Ohio.

Most grades of carbon and alloy steels in strip form, including stainless steels. For property and application data, see "Stainless Steels" listing at end of this section.

THIOKOL (Synthetic rubber) — Thiokol Corp., Trenton, N. J.

Available in three types; crude, corresponding to crude rubber, water dispersions for coatings, and liquid polymers; processed in manner similar to rubber; oil corrosion and solvent resistant. Used for hoses carrying oil or gasoline, gaskets, packing, pipeline rings, diaphragms, newspaper printing blankets, etc.

THOMASTRIP (Cold-rolled strip steel)—Thomas Steel Co., Warren, Ohio.

Bright finish electro-coated in brass, nickel, zinc, and copper. Hot-dipped tin and solder. Lacquer coated in colors. Carbon and alloy specialties.

TIGER (High-leaded bronze)—National Bearing Div., American Brake Shoe Co., St. Louis 10.

Furnished in rough bars or billets, finished rods or bars, sand castings and centrifugal castings. In unheat-treated state: Ts, 30,000 psi; ys, 17,000 psi; elong in 2 in., 15%; bhn, 50-70 (500 kg); nonmagnetic; machinability, good; weldability, fair; abrasion resistance, medium. Used primarily as a backing material for bearings.

TIGERLOY (Alloy cast steel)—Massillon Steel Castings Co., Massillon, O.

Nickel-molybdenum; for shovel castings, gears, crane track wheels, castings for impact resistance, etc.

TIMKEN (Steels)—The Timken Steel & Tube Div., Timken Roller Bearing Co., Canton, Ohio.

All standard AISI types of alloy and stainless steels in standard forms. Also AISI carbon steels for mechanical tubing. For property and application data on stainless steels, see "Stainless Steels" listings at end of this section.

91140 Steel; an alloy steel containing 0.40-0.70 graphitic carbon; furnished in ingots, rough bars and billets, finished rods or bars, straight and coiled strip, wire, sheet, and plates. In heat treated state, ts, 164,000 psi; ys, 136,000 psi; elong in 2 in., 13%; Bhn, 302; weldability, good; abrasion resistance, high. For spindles, lathe ways, gears, valve tappets, pneumatic hammer parts, etc.

TI-NAMEL (Vitreous enameling steel)—Inland Steel Co., Chicago 3.

Low-carbon titanium vitreous enameling steel furnished usually in sheet or strip, but may be obtained in plates or bars. Produced primarily for its vitreous enameling characteristics. Can be used in hot and cold working, stamping, drawing, brazing, and welding. Used for food and dairy machinery, beverage machinery, washing machines, refrigerators, stoves, etc.

TI-NIC-O-SIL (Nickel-silver forging alloys)—Titan Metal Mfg. Co., Bellefonte, Pa.

No. 14: Has excellent white color; not quite as forgeable as No. 53. Ts, over 85,000 psi. Composition: Cu 31-44, Ni 15-20, Zn balance.

No. 53: Contains about 10% nickel, forges with same ease as forging-quality brass. Close forging tolerances can be held. For forged parts requiring white color and good corrosion resistance combined with moderate strength.

No. 54: Nickel-silver, white color; Cu 46.85, Pb 2.50, Mn 2.00, Ni 11; balance Zn. Exceptional corrosion resistance; high strength; free machining; takes high polish. For hardware, valve parts, bottling machines, automobile accessories, electrical contacts, etc.

TIOGA (Alloy steel)—Allegheny Ludlum Steel Corp., Brackenridge, Pa.

C 0.68, Mn 0.60, Si 0.25, Cr 0.65, Ni 1.40 and Mo 0.20. Hardness, 64 rockwell C. Is nondeforming and shock-resisting; for clutch parts, cams, arbors, spindles, gears, shafts, guide pins, chuck jaws, keys, drawbench links and pins, stressed bolts and studs.

TISCO (Alloy steels and magnet metals)—Taylor Wharton Iron & Steel Co., High Bridge, N. J.

Manganese steel; C 1.00-1.40, Mn 11.0 min, Si 1.0 max, S 0.05 max, P 0.10 max. Furnished as sand castings. Ts, 80-120,000 psi; ys, 40-50,000 psi; elong in 2 in., 15-35%; bhn, 180-200; nonmagnetic; max cont serv temp, 300 F; abrasion resistance, high. For wearing parts for excavating, crushing and reduction machinery.

Timang; manganese-nickel steel; C 0.60-0.80, Mn 13.0-15.0, Ni 2.75-3.25; furnished in finished rods or bars, wire and plate, and as sand castings; for arc welding. Ts, 135-155,000 psi; ys, 45-55,000 psi; elong in 2 in., 50-80 per cent; endurance limit (completely reversed bending), 50,000 psi; bhn, 170-210; nonmagnetic; weldability, good; max cont serv temp, 500 F; abrasion resistance, high. For welding rods and abrasion-resisting plates and screens.

Alnico; magnet metal; of aluminum, nickel, cobalt and iron; furnished as sand castings. In untreated state: Ts, 4197 psi; sp gr, 6.9; highly magnetic; corrosion and abrasion resistance, high. Used for permanent magnets.

Alloy No. 80; Nickel-chromium-molybdenum steel furnished as sand castings; in heat treated state, ts, 173,000 psi; ys, 165,000 psi; elong in 2 in., 8%, Bhn, 350; is magnetic; weldability, fair; abrasion resistance, high. For crushing parts, sand pumps, and various castings subjected to abrasion without shock.

Alloy No. 23X; medium manganese-chromium-molybdenum steel; furnished as sand castings to specification; in water-quenched, heat-treated state, ts, 90-110,000 psi; ys, 68-90,000 psi; elong in 2 in., 20-30%; bhn, 210-260; weldability, good; abrasion resistance, medium. For structural applications where high strength and shock resistance are required.

TITAN (Copper-base alloys)—Titan Metal Mfg. Co., Bellefonte, Pa.

Naval brass; Cu 60, Sn 0.75, Zn balance. Ts, 60,000 psi; ys, 28,000 psi; elong, 40%; hardness, 55 Rockwell B. Machinability, fair; corrosion resistant; good sea-water resistance.

Manganese bronze: Cu 59, Sn 0.75, Fe 1, Mn 0.40, Zn balance. Ts, 68,000 psi; elong, 33%; hardness, 80 Rockwell B. Machinability, fair; corrosion resistance, good.

Aluminum-silicon bronze: Al 7, Si 2, Cu balance. Ts, 90,000 psi; ys, 45,000 psi; elong, 30%; hardness, 85 Rockwell B. Machinability, fair; corrosion resistance, excellent.

TITAN (Bronze welding rods)—Titan Metal Mfg. Co., Bellefonte, Pa.

Alloy W-20: Brazing bronze; ts of V-weld, 42-48,000 psi; hardness of weld, 47-50 Rockwell B; melting point, 1623 F; shear str, 62,500

psi; fuming, single deoxidation; good tinning; very good flow.

Alloy W-60: Naval bronze; ts of V-weld, 44-50,000 psi; hardness of weld, 55-58 Rockwell B; melting point, 1625 F; shear str, 56,850 psi; fuming; single deoxidation; good tinning; very good flow.

Alloy W-21: Bronze; ts of V-weld, 46-52,000 psi; hardness of weld, 63-65 Rockwell B; melting point, 1615 F; shear str, 68,500 psi; low fuming; double deoxidation; good tinning; excellent flow.

Alloy W-17: Manganese bronze; ts of V-weld, 50-53,000 psi; hardness of weld, 62-66 Rockwell B; melting point, 1620 F; shear str, 63,450 psi; low fuming, double deoxidation; good tinning; very good flow.

Alloy W-46: Wear Well bronze; ts of V-weld, 45,000 psi; hardness of weld, 83-93 Rockwell B; melting point, 1590 F; low fuming; double deoxidation; good tinning; very good flow.

TITANATES (Ceramic)—General Ceramics & Steatite Corp., Keasbey, N. J.

Furnished in sheet, rods, tubes and plates. Abrasion resistance, high; max cont serv temp, 1700 F; nonflammable; flexibility, low; dielectric str, 185 volts per mil; transverse str, 15,000 psi; moisture absorption, low; available in straw color, opaque; sp gr, 6-7. Used as dielectric material in manufacture of condensers.

T-LOYS (Steel castings)—Unitcast Corp., Steel Casting Div., Toledo 9, O.

No. 4: Abrasion-resistant, silicon-molybdenum steel with excellent hardening properties. Used for mining tools, wear plates, crusher plates and pinions.

No. 6: Air-hardening die steel of uniform machining qualities; long life under severe wear.

No. 34: C 0.30-0.37, Mn 0.70-0.85, Ni 0.70-0.95, Cr 0.50-0.70, Mo 0.18-0.25; furnished as castings to meet 4B, 4C2, 4C3 Army specifications. Can be oil or water-quenched. General physical specifications: Ts, 100,000 psi; ductility, high; bhn, 217-241; machinability, good.

No. 42: C 0.37-0.45, Mn 0.70-0.85, Ni 1.00-1.25, Cr 0.70-0.85, Mo 0.25-0.35. Has higher strength and hardenability. Will oil quench to higher and deeper hardness. Used for wear plates, scarifier teeth, etc. Machinability, good at 220-260 Brinell.

No. 131: C 0.22-0.28, Mn 0.7-0.8, Cu 1-1.2, V 0.04-0.08, Si 0.4-0.5; furnished in castings. Ts, 90-100,000 psi; ductility, high. For use where high strength and ductility is desired rather than hardenability.

TOBIN (Bronze)—American Brass Co., Waterbury, Conn.

Cu 60, Zn 39.25, Sn 0.75; abrasion-resistant. Uses include piston rods, boat shafting, condenser head plates, welding rods, seamless tubes, etc.

TOMBASIL (Copper-base alloys) — Ajax Metal Co., Philadelphia 23, Pa.

A; Cu 81.5, Si 4.8, Zn 13.7. In untreated state: Ts, 65,000 psi; ys, 40,000 psi; elong, 15 per cent; bhn, 140; sp gr, 8.25; nonmagnetic; weldability, good.

Navy; analysis in accordance with Navy Dept. Spec. 46B28. Cu 90, Si 5 max, Zn 5. In untreated state: Ts, 55,000 psi; ys, 20,000 psi; elong, 40 per cent; bhn, 105; sp gr, 8.25; nonmagnetic; weldability, good.

TONCAN (Iron)—Republic Steel Corp., Cleveland 1.

An open-hearth iron alloyed with 0.40% min copper and 0.05% min molybdenum. Resists corrosion caused by atmosphere, water, oils and process materials; ts, 48-58,000 psi min; comp str, 40,000 psi; bhn, 90-120. For sheet-metal applications.

TOOL-ARC (Welding electrodes)—Alloy Rods Co., York, Pa.

Electrodes for welding tool steels.

TOOLFACE (Welding rod)—American Manganese Steel Div., American Brake Shoe Co., Chicago Heights, Ill.

C-Cr-Mo-W-V: For hard facing only; bhn, 550-650; martensitic steel deposits, magnetic, air hardening. High abrasion and impact resistance; responds to heat treatment and can be forged. For hard facing cutting tools, forging dies, for manufacture of composite tools. For general hard facing for extreme hardness and shock resistance.

TOOLWELD (Welding electrode)—Lincoln Electric Co., Cleveland.

Type 60; coated arc welding electrode, deposited hardness of 60-65 rockwell C; hardness retained to 1000 F; deposit can be heat treated same as high-speed steel. For building hard, tough cutting edges on cold-rolled steel and for other applications requiring super-hardness.

Type A & O; similar to above except used when greater impact resistance is desired. Oil and air hardening. Satisfactory on wide variety of tool steels.

TOPHET (Nickel-chromium alloys)—Wilbur B. Driver Co., Newark, N. J.

Type A; approx. 80 Ni and 20 Cr; resists heat to 2100 F. Supplied in wire and strip form; for electrical heating applications.

Type C; Ni 60, Cr 15, and balance Fe; resists heat to 1800 F. Supplied in wire and strip form; for electrical resistance and heating application.

TRANSFLEX (Thermoplastic plastics)—Irvington Varnish & Insulator Co., Irvington, N. J.

Polyvinyl chloride; furnished in tubing and rods for extruding. When used as conduit permits quick identification of coded enclosed leads and location of wire breaks; unusual elongation facilitates stretching over lugs, splices and other projections; does not become brittle at temperatures as low as —58 F; max cont serv temp, 170 F; ts, 3000 psi; dielectric str, 1000 volts per mil (dry); 800 volts per mil (wet); for tubing wall thickness approximately 0.020-in.; sp gr, 1.2; moisture absorption, low. Designed for moderately low temperature applications; wire insulation, conduit, etc.

TRANTINYL (Alloy steels)—Youngstown Alloy Castings Corp., Youngstown, O.

Furnished as sand castings. High abrasion resistance; medium ductility; high tensile strength. Used for tools for tube and bar mills such as guide shoes, plugs, guides, etc.

TREMBRONZE (Bronze strip)—The Miller Co., Meriden, Conn.

Strip bronze furnished in coils; Cu 92, Sn 2, P 0.15, balance, zinc. In cold worked state, ts, 91,000 psi; ys, 82,000 psi; elong in 2 in., 2%; hardness, Rockwell C, 85-88; sp gr, 0.32; is nonmagnetic; weldability, good; max cont serv temp, 350 F; abrasion resistance, medium. Used with excellent results in the manufacture of electrical control equipment, switches, etc.

TRENITE (Cast iron)—Trenite Corp., Trenton, N. J.

Furnished as sand castings to specification; heat treatment unnecessary; ts, 45,000 psi; Bhn, 275; is magnetic; weldability, good; abrasion resistance, high.

TRENTWELD (Stainless tubing)—Trent Tube Mfg. Co., East Troy, Wis.

Austenitic stainless steels, in welded tubing. Recommended heat treatment, standard annealing practice for austenitic stainless steels. Ts, 75,000 psi min; ys, 40,000 psi min; elong in 2 in., 35%; hardness, Rockwell B, 80 max; nonmagnetic. For use where corrosive environment is such that stainless steels are required. Also produces Inconel tubing for applications requiring heat resistance.

TRI-CORE (Rosin-filled solder)—Alpha Metals, Inc., 363 Hudson Ave., Brooklyn 1, N. Y.

Various tin-lead solders for use wherever non-corrosive rosin fluxes are demanded. Company also produces lead, tin, antimony, bismuth and white metals in pig or ingot, rough bars or billets, finished rods or bars, straight and coiled strip, tubing, wire, sheet, plate, powder metal and in permanent-mold castings and die castings.

TRINDLE SPEEDWELD (Mild steel welding rod)—Trindle Products Ltd., Chicago 16.

High-grade, deep-penetrating, mild steel, general-purpose shielded arc welding electrodes, for use with a-c transformer type machines or on straight polarity with d-c welders. Available in diameters from 1/16 to ¼-in.

TRITEX NO. 2 (Thermalized manganese steel)—La Salle Steel Co., Hammond, Ind.

C 0.40-0.48, Mn 1.35-1.65, P 0.045 max, S 0.24-0.33, Si 0.10-0.25; furnished in finished bars for machining. Available both cold finished, ground and polished. Induction harden and quench, 1550 F, temper to desired hardness. Free from warpage. For leadscrews and key shafts, or, if heat-treated, gears and shafts.

TRODALOY (Resistance welding electrode) — General Electric Co., Schenectady, N. Y.

No. 1; Co 2.6, Be 0.4, and Cu 97; has 55 per cent conductivity of copper. In heat-treated state: Ts, 90-120,000 psi; impact resistance, high; bhn, 220. For resistance welding electrodes, soldering iron tips, springs, bushings, castings, brake drums, etc. No sales made through General Electric Co. Various Trodaloy items sold through following licensees: P. R. Mallory Co., Ampco Metal Co., Wilbur B. Driver Co., Electroloy Co. and Welding Sales & Engineering Co.

No. 7; generally consists of Be 0.1, Cr 0.4 and Cu 99.5; furnished in rough bars or billets, finished rods or bars, wire, strip, plates for hot forging, stamping, extruding, turning, boring and as sand castings. In heat-treated state: Ts, 45-70,000 psi; impact resistance, high; endurance limit (completely reversed bending), 18-25,000 psi; bhn, 90-140; nonmagnetic. Used for resistance welding electrodes, high conductivity springs and castings, and substitute for P-bronzes.

T.R.S. (Tool steel)—Amalgamated Steel Corp., Cleveland, O.

C 0.33, Mn 0.70, Cr 0.80, W 0.30, and Mo 0.45. Furnished in rough bars or billets, finished rods or bars and forgings. In unheat-treated state: Ts, 134,000 psi; elong in 2 in., 16%; machinability, about 70% of B1112; weldability, very good; abrasion resistance, high. For locator pins, lead screws, gears and racks, spindles, severely loaded shafts, toggle cams, chuck jaws and cutter arbors, etc.

TRUALOY (Bronze and aluminum alloy castings)—True Alloys Inc., Detroit 9.

Aluminum bronze: Cu 86-89, Fe 2-3, Al 8-10; for sand castings and permanent-mold castings. In untreated state: Ts, 65,000 psi; ys, 28,000 psi; elong in 2 in., 20%; bhn, 135; weldability, good; abrasion resistance, high. For high strength, wearing surfaces under load and low speed.

Aluminum: Cu 3, Si 4, Al balance; for sand and permanent-mold castings. In untreated state: Ts, 26,000 psi; elong in 2 in., 2%; bhn, 85; weldability, good; resists corrosion caused by salt water; abrasion resistance, medium. For polished castings where high strength, hardness and lightness are required.

Bearing bronze: Sn 8-10, Pb 15, Cu balance; for sand and permanent-mold castings. In cold-worked state: Ts, 25,000 psi; ys, 12,000 psi; elong in 2 in., 8%; weldability, good; abrasion resistance, high. For bearings under load and low pressure.

Manganese bronze: Cu 60, Zn 24, Fe 2, Al 4; for sand and permanent-mold castings. In cold-worked state: Ts, 65,000 psi; ys, 12,000 psi; elong in 2 in., 20%; weldability, good; abrasion resistance, medium. For parts requiring high strength with high elongation.

Also produce castings from all SAE, AISI and ASTM castings specifications.

TRU-CON (Copper sand castings)—True Alloys Inc., Detroit 9.

Furnished to specification, heat treated. In heat treated condition properties are: Ts, 45,000 psi; ys, 20,000 psi; elong in 2 in., 15%; bhn, 120; is nonmagnetic; machinability, good; weldability, fair; electrical conductivity, 80%. Used where hardness plus good conductivity are required.

TRUFLEX (Thermostat metals)—General Plate Div. of Metals and Controls Corp., Attleboro, Mass.

Available in sheets or strips in long lengths, flattened and coiled, or cut to length—

spiral, helix or double-helix coils—also fabricated parts, and welded or riveted subassemblies with solid-silver or laminated electrical contacts or mounting brackets. For control or indication of temperature and for compensating movement required in assemblies due to changes in temperature.

TRU-SIZE (Plastics tubing)—Yardley Plastics Co., Columbus, O.

Thermoplastic plastic tubing of the following base: Cellulose acetate, cellulose acetate butyrate, ethyl cellulose, methyl methacrylate, polystyrene and vinyl chloride acetate. Supplied in all colors. Used for vacuum cleaners, electrical equipment, sight gages, etc.

TUBE TUNGSITE (Hard-facing rods)—American Manganese Steel Div., American Brake Shoe Co., Chicago Heights, Ill.

Tungsten carbide for hard-facing oil-well and earth-drilling equipment. Also applications requiring a serrated edge such as rotary drill bits, dredge cutter heads, scraper blades, sand plows, reamers, rock bits, scarifier teeth, shale planer knives, etc.

TUFALOY (Alloy steel castings)—Fort Pitt Steel Castings Div., McKeesport, Pa.

Intermediate manganese or manganese-molybdenum cast steel; ts, 72-165,000 psi; ys, 40-140,000 psi; elong in 2 in., 31-14%; Bhn, 153-302; max cont serv temp, 1100 F. For application where resistance to shock, abrasion and high pressures and temperatures are the principal consideration.

TUF-FLEX (Tempered plate glass) — Libbey-Owens-Ford Glass Co., Toledo, O.

Polished plate glass heat tempered, furnished in sheet and laminated form; resists corrosion caused by moisture and all common acids except hydrofluoric acid; heat resistant to 550 F; flexibility, medium; dielectric str, 0.204 kilovolts per mil; modulus of rupture, 30,000 psi; not shatterproof but 4-5 times stronger than plate glass; produced in clear and colors; sp gr, 2.52. For machine guards, observation and inspection windows, sight glasses, gage glasses, etc.

TUF-STUFF -224E (Aluminum-bronze)—Mueller Bros. Co., Port Huron, Mich.

Cu 89, Al 10, Fe 1; furnished in finished rods or bars. Ts, 85-95,000 psi; ys, 55-80,000 psi; elong in 2 in., 12-25%; hardness, Rockwell B, 85-93; is highly resistant to acids and alkalies. Used where high strength and corrosion resistance is required and where excessive hardness is not a factor. For valve seat inserts, valve guides, airplane engine parts, etc.

TUFTEST (Cast iron) — The Medart Co., St. Louis.

For parts subject to excessive abrasion such as guiding disks; machinability, good.

TULOX (Thermoplastic plastics tubing) — Extruded Plastics Inc., Norwalk, Conn.

A; cellulose acetate thermoplastics; furnished in tubing to full range of brilliant colors; transparent, translucent and opaque; odorless and tasteless. More rigid than EC and TT types. Heat resistant to 160 F; ts, 4-600 psi; sp gr, 12.8.

EC; ethyl cellulose thermoplastic, rigid; furnished in tubes; medium abrasion resistance; high impact strength at low temperature; transparent colors, translucent, opaque, no crystal clear. Tubular parts for use where high impact strength is required over a range of —40 F to 150 F.

TT; cellulose acetate thermoplastic, furnished in extruded tubes in sizes from 0.100-2½ in. OD; abrasion resistance, medium; heat resistant to 160 F; flexibility, low; ts, 4-5000 psi; moisture absorption, low; available in color; sp gr, 1.2; shatterproof; transparent, translucent, opaque; machinability, good. For use as gage glasses, separators and small machine parts produced on screw machine, etc.

TUNGROD (Hard-facing rod)—American Manganese Steel Div., American Brake Shoe Co., Chicago Heights, Ill.

Tungsten carbide for hard-facing earth-working, drilling and scraping equipment. Excellent for hard-facing thin edges such as coal cutter bits, core cutters, cane knives, plow shares, cultivator spades, etc.

TURBO (Varnished insulating materials)—William Brand & Co., New York 10.

Varnished cotton, glass tubing, plastics extruded tubing, varnished cloth, tapes, and mica. Furnished in tubing. Max cont serv temp, 180 F; noninflammable; flexibility, high; dielectric strength, 1000 volts per mil; moisture absorption, low. Conforms to ASTM standards. Used for electrical insulation.

TWINDOW (Insulating glass)—Pittsburgh Plate Glass Co., Pittsburgh 19.

Prefabricated glass units consisting of two or more pieces of glass enclosing a small hermetically sealed air space. Hollow aluminum tubing separates the pieces of glass. The entrapped air is at atmospheric pressure. Entire edge of each unit is encased in a stainless steel channel. Available in sizes to specification.

TYER (Molded rubber)—Tyer Rubber Co., Andover, Mass.

Natural and synthetic rubbers, custom molded to meet customers' specifications.

TYGOFLEX (Thermoplastic plastics) — United States Stoneware Co., Akron 9.

Furnished in liquid form for injection and compression molding, casting and extruding. Type 40, as molded, ts, 900 psi; durometer hardness (Shore A) 40 plus or minus 2; sp gr, 1.15; ultimate elongation, 400%; permanent set, 25%; water absorption, 1.5%. Can be used as a coating on metals, ceramics, glass, heat-resistant plastics, as well as for molding and casting into parts.

TYGON (Thermoplastics plastics)—United States Stoneware Co., Akron 9.

Furnished in flexible or rigid sheets, tubing, rods, or in liquid form; may be molded cast or extruded. Abrasion, impact and corrosion-resistant, unaffected by oil, gasoline, water; nonaging; high dielectric and tensile strength. May be transparent, translucent or opaque; available in colors. Nontoxic. For molded machine parts, gaskets, tubing, etc.

TY-LOY (Abrasion-resistant metal)—W. S. Tyler Co., Cleveland.

Special composition metal resistant to abrasive action. Wire screens of this material withstand severe abrasive conditions. Many sizes of square mesh and oblong-opening screens can be made of Ty-Loy.

U

UFORMITE (Plastics resins)—Resinous Products & Chemical Co., Philadelphia 5.

Synthetic resin adhesive, urea-formaldehyde; furnished in powder form; has low moisture absorption, high density. Used in manufacture of waterproof plywood for aircraft and marine use.

U-LOY (Copper bearing steel)—Republic Steel Corp., Cleveland 1.

Has good corrosion resistance, available in hot-rolled and galvanized sheets.

ULTRA-CUT (Bessemer rod)—Bliss & Laughlin Inc., Buffalo, N. Y.; Harvey, Illinois; Mansfield, Mass.

High sulphur bessemer screw stock furnished in cold finished bars. For miscellaneous automatic screw machine parts.

ULTRON (Plastics)—Monsanto Chemical Co., Plastics Div., Springfield 2, Mass.

Polyvinyl chloride, polyvinyl acetals, copolymers and vinyl butyral. Furnished as film, rigid sheets, resins, dispersions and compounds. Physical form varies from hard, rigid to elastomeric. Wide range of colors including transparents, translucents and opaques. A variety of surface finishes can be produced; excellent mechanical properties; unaffected by common weak acids and alkalies; in rigid forms excellent dimensional stability and noninflammable.

UNIMETAL (Welding rod) — Unimetal Co., Franklin, Pa.

Zinc-base welding rod for use in joining white metals or aluminum. For oxyacetylene welding of such items as molds, patterns, die castings, etc.

UNISORB (Noise and vibration damping material)—The Felters Co., Boston 11.

A special material for simplifying anchoring of machinery and equipment on all types of floors; absorbs from 60 to 85% of transmitted vibration and noise. Pads grip machine feet on top, floor on bottom; no other anchoring devices necessary. Holding strength, 1500 lbs per square foot, minimum. Petroleum-resistant.

UNITED AMERICAN (Babbitt)—United American Metals Corp., Brooklyn 22, N. Y.

Government genuine babbitt; furnished in bars. In cold-worked state: Ts, 7100 psi; comp str, 18,250 psi; ys, 7700 psi; elong in 2 in., 0.015 per cent; bhn, 28.3. For heavy-duty high-speed engines.

Diesel machine genuine babbitt; furnished in bars. In cold-worked state: Ts, 9760 psi; comp str, 11,740 psi; ys, 7700 psi; elong in 2 in., 0.11 per cent; bhn, 24.8. For diesel type marine engines.

Manganese babbitt; furnished in bars. In cold-worked state: Ts, 11,400 psi; comp str, 19,450 psi; ys, 8000 psi; elong in 2 in., 0.015 per cent; bhn, 21. For general heavy service.

U. S. RUBBER (Natural and synthetic)—U. S. Rubber Co., New York 20.

For hose, belting, packing, ducts, wire and cable and vibration absorbers. Furnished in sheet, strip, rods or tubes, plate and fluid for molding, stamping, or extruding. Properties to specifications desired.

"U. S." STANDARD (Chemical stoneware)—United States Stoneware Co., Akron 9.

Acid-proof; available in a wide range of shapes and sizes; resists all corrosives except hydrofluoric acid and hot caustics; for fabrication into tanks, etc., and for lining exhausters and acid-pumps. Hard, durable, available in heat-shock resistant bodies.

U. S. S. (Sheet steels)—Carnegie-Illinois Steel Corp., Pittsburgh 30; Tennessee Coal, Iron & Railroad Co., Birmingham 2.

Paintbond: Galvanized steel sheet for stamping and forming into cases, cabinets, etc.

Galvannealed: Galvanized steel sheet for stamping and forming into cases, cabinets, air ducts, dust collectors, etc.

Vitrenamel: Sheet for porcelain enameled jackets, casings, trays, cabinets, etc.

Electrical Sheets: Also strips, for parts requiring electrical properties. Copper Steel: Available in strip, sheet and plate for general sheet metal parts.

Hot-Rolled Sheets and Strip: For sheet metal parts where finished appearance is of secondary importance.

Cold-Rolled Sheet: For sheet metal parts requiring severe forming and where good finish is important.

Also Galvanized sheets and Long Terne sheets.

U. S. S. AMERCUT (Carbon and alloy steels)—American Steel & Wire Co., Cleveland.

Cold finished carbon and alloy steel bars either cold drawn, annealed, normalized, spheroidized or quenched and tempered to meet various combinations of definite physical, magnetic, corrosion-resistant or machinability properties specifications.

U. S. S. AMERICAN QUALITY (Carbon and alloy steels)—American Steel & Wire Co., Cleveland.

Carbon steels and alloys in the form of cold rolled strip, manufacturer's wire and springs.

U. S. S. AR STEEL (Abrasion resisting steel)—Carnegie-Illinois Steel Corp., Pittsburgh; Columbia Steel Co., San Francisco; and Tennessee Coal, Iron & Railroad Co., Birmingham 2.

C 0.35-0.5, Mn 1.5-2, P 0.05 max, Si 0.15-0.3, furnished in bars, sheets, strip, plates and shapes; high abrasion resistance; bhn, approx 200-275 as rolled; heat-treated, 350-450. Used for wear resisting surfaces.

U. S. S. CARILLOY (Standard alloy steels)—Carnegie-Illinois Steel Corp., Pittsburgh; Columbia Steel Co., San Francisco; and Tennessee Coal, Iron & Railroad Co., Birmingham 2.

Alloy steels in all standard grades of AISI and SAE steels sold under the above trade name.

U. S. S. COR-TEN (High-strength steel)—Carnegie-Illinois Steel Corp., Pittsburgh; Columbia Steel Co., San Francisco; American Steel & Wire Co., Cleveland; and Tennessee Coal, Iron & Railroad Co., Birmingham 2.

C 0.12 max, Mn 0.3-0.5 max, P 0.07-0.15, Si 0.25-0.75, Cu 0.25-0.55, Ni 0.65 max; furnished in bars, sheets, strip, plates, structural and bar shapes, for hot and cold forming, welding, riveting, etc. Resists atmospheric corrosion four to six times that of plain carbon steel; abrasion resistance, good; ys, 50,000 psi min; ts, 70,000 psi min; good ductility; weldability, good. Used for light weight construction, where atmospheric corrosion-resistance is a major factor; structural and body members on mobile equipment.

U. S. S. MANG-NI-CU (Steel)—Carnegie-Illinois Steel Corp., Pittsburgh 30.

C 0.25 max, Mn 1.40 max, P 0.045 max, S 0.05 max, Si 0.25 max, Cu 0.30-0.60, Ni 0.50-1.00. Furnished in rough bars or billets, finished rods or bars, strips (coiled), sheets, plates and structural shapes, for hot and cold forming, riveting, etc. Resistance to corrosion 3 times that of plain carbon steel; abrasion resistance, good; ductility, good; weldability, good; ys, 50,000 psi min; ts, 70,000 psi min. Used for lightweight construction where atmospheric corrosion and welding are of major importance.

U. S. S. MAN-TEN (High-strength steel)—Carnegie-Illinois Steel Corp., Pittsburgh; Columbia Steel Co., San Francisco; and Tennessee Coal, Iron & Railroad Co., Birmingham 2.

C 0.25 max, Mn 1.1-1.6, P 0.04 max, S 0.05 max, Si 0.3 max, Cu 0.2 min; furnished in bars, sheets, strip, plates, structural and bar shapes for hot and cold forming, welding and riveting. Corrosion-resistant; high abrasion resistance; ys, 50,000 psi min; ts, 75,000 psi, min. Used for lightweight construction where atmospheric corrosion resistance is not a major factor.

U. S. S. PREMIER (Spring steel)—American Steel & Wire Co., Cleveland; Columbia Steel Co., San Francisco; Tennessee Coal, Iron & Railroad Co., Birmingham 2.

Special processed steel spring wire having high yield and fatigue strength.

U. S. S. SHELBY (Mechanical tubing)—National Tube Co., Pittsburgh.

May be obtained in many different grades from low carbon steel to the stainless grades of alloy steel suitable for various uses in the automotive, aircraft and machine tool industries. Available in sizes up to 10¾ in. OD according to grade and intended use. Made to AISI standards and various industry and government specifications.

U. S. S. STAINLESS (Stainless steels)—American Steel & Wire Co., Cleveland; Carnegie-Illinois Steel Corp., Pittsburgh 30; Columbia Steel Co., San Francisco; National Tube Co., Pittsburgh; Tennessee Coal, Iron & Railroad Co., Birmingham 2.

Stainless steels in standard forms to AISI Specs. For type, property and characteristics data see "Stainless Steels" listing at end of this section.

UNIVAN (Alloy steel castings)—Union Steel Castings Div., Blaw-Knox Co., Pittsburgh 1.

C 0.30, Mn 1.00-1.20, Si 0.35, Ni 1.40-1.60, V 0.12, P 0.05 max, S 0.05 max. Furnished in sand castings to specification. Normalized and drawn: Ts, 90,000 psi; ys, 60,000 psi; elong in 2 in., 25%; impact str (Charpy), 30 ft-lb min. at room temp; bhn, 185-190; is magnetic; machinability, good; weldability, good; abrasion resistance, high. For all castings where toughness, strength and resistance to rapid temperature changes or shock are required, such as charging boxes, charging peels, locomotive wheel centers, locomotive crossheads, etc.

UNIVAN "C" (Alloy steel castings)—Union Steel Castings Div., Blaw-Knox Co., Pittsburgh 1.

C 0.35-0.45, Mn 1.25-1.45, Si 0.35, Cr 0.50, Mo 0.20, P 0.05 max, and S 0.05 max. Furnished in sand castings to specification. As normalized and drawn: Ts, 85,000 psi; ys, 55,000 psi; elong in 2 in., 22%; impact str (Charpy), 25 ft-lb min. at room temp; bhn, 195-200; is magnetic; machinability, good; weldability, good; abrasion resistance, high. For all castings where resistance to wear is important, such as coupling boxes, spindles, gears, etc.

UNIVERSAL (Porcelain)—The Universal Clay Products Co., Sandusky, O.

Ceramic-base material for molding into parts. Resists corrosion caused by acids, climatic exposure and fumes, with the exception of hydrofluoric acid; heat resistant to 500 F; moisture absorption, low; available in color; sp gr, 2.3-2.5; opaque. For use in electric insulation.

USALITE 1350 (Ceramic)—Stupakoff Ceramic & Mfg. Co., Latrobe, Pa.

Furnished in rods and tubes. Max cont serv temp, 2400 F; noninflammable; flexibility, low; ts, 7000 psi; comp str, 30,000 psi; flexural str, 5000 psi; moisture absorption, medium; available in white; opaque; sp gr, 2.3. For use in pyrometers, etc.

UTICA (Aluminum and magnesium castings)—Utica Radiator Corp., Utica 2, N. Y.

Sand castings of various aluminum and magnesium alloys supplied to specification.

V

VALITE (Laminating resin)—Valite Corp., New Orleans 12.

No. 8123, laminating resin; thermosetting; for impregnating duck, paper, etc. For housings, silent gears, mountings, switches, etc.

VANADIUM PERMENDUR (Electrical steel)—Allegheny Ludlum Steel Corp., Brackenridge, Pa.

A high-density, high-saturation alloy of cobalt, vanadium and iron. Furnished in cold rolled strip, bars and laminations. Has high magnetic saturation. For diaphragms, high density dc cores.

VECTOLITE (Magnet material)—General Electric Co., Chemical Dept., Pittsfield, Mass.

Nonmetallic, nonconducting magnet material; hardened sintered combination of iron oxide and cobalt oxide mixed when still in powder form. Light in weight and nonconductive properties prevent electrical losses. Has high coercive force or resistance to demagnetizing forces.

VELLUMOID (Sheet packing)—The Vellumoid Co., Worcester 6, Mass.

A vegetable fiber base composition impregnated with glue and glycerine. For all-around general gasket requirements; recommended for use under ordinary flange conditions for oils, gasoline, greases, etc., or constant water service where temperatures encountered do not exceed approximately 300 F. Does not become hard or brittle upon drying; ts, 2000 psi minimum.

VELLUTEX (Gasket material)—The Vellumoid Co., Worcester 6, Mass.

Composed of a special fiber base saturated with an impregnant of specially prepared oils and resins. For use where temperatures do not exceed 250 F; especially suitable for gaskets in contact with nonferrous metals and their alloys, particularly where corrosion is a factor and where intermittent wet and dry conditions are prevalent. Material is not affected by acids and alkalies up to 10% concentration, gasoline, animal, vegetable and mineral oils, alcohol, Freon, methyl and ethyl chlorides, salt solutions, etc. Compressibility, 18-22% of original thickness when compressive force of 400 psi is applied. Ts, 1500 psi for thicknesses up to 1/32 in. (minimum); resists crushing at flange pressures up to 8000 psi. Supplied in thicknesses from 1/64-in. to 0.050-in.

VELVETOUCH (Friction materials)—The S. K. Wellman Co., Cleveland.

Bimetallic friction materials consisting of a combination of various powdered metals such as copper, tin, lead and other powdered materials compressed, sintered and welded to a solid metal backing for support. Applications include clutch and brake facings, clutch disks, thrust bearings, etc.

VERTEX (Arc welding electrode)—Metal & Thermit Corp., New York 5.

For general machine part use. Weld deposit: Ts, 62-70,000 psi; ys, 52-60,000 psi; elong in 2 in., 22-30%.

VIBRIN (Plastics resin)—Naugatuck Chemical Div., U. S. Rubber Co., New York.

Polyester thermosetting material; furnished in liquid form, for casting, laminating, impregnating and molding. Available in different grades. Grade 103 has medium abrasion resistance and excellent chemical resistance; flex str, 17,000 psi; dielectric str, 2000 volts per mil (0.005-in. sample); ts, 10,000 psi; impact str, 10.3 ft-lb (Izod); from pale yellow to colorless, transparent; moisture absorption, low; sp gr, 1.16. For knobs, covers, etc., and laminated structures of light weight, high strength and decorative appeal.

VICTOLENE (Synthetic rubber)—Victor Mfg. & Gasket Co., Chicago.

Thermosetting material, furnished in sheets and stampings, for molding into parts; resists corrosion caused by oil, gasoline, kerosene, salt water and antifreezers; heat resistant to 250 F; flexibility, high; ts, 350 psi; moisture absorption, medium; inflammable; available in brown; shatterproof; sp gr, 1.12; opaque. For gasketing material, when compressed in position by light metal or plastic stampings; used for sealing fluids.

VICTOPAC (Asbestos-base sheet)—Victor Mfg. & Gasket Co., Chicago.

Compressed sheet packing with asbestos base for stamping or cutting by hand into parts; high corrosion resistance; flexible; ts, 2500 psi; heat-resistant; low moisture absorption; nonflammable; impact-resistant; high compressive strength. Used for gasketing and packing.

VICTOPRENE (Elastic plastics)—Victor Mfg. & Gasket Co., Chicago.

Synthetic elastic, thermosetting; furnished in sheet or molded form. Sheets may be stamped and blanked into parts; corrosion and heat resistant; ts, 1500 psi; low moisture absorption; shatterproof. Used as a gasketing material.

VICTOR (Asbestos sheet)—Victor Mfg. & Gasket Co., Chicago.

Asbestos fiber base; furnished in sheets for stamping or cutting into parts. Corrosion-

resistant; flexible; ts, 300 psi; heat resistant to 700 F; nonflammable; sp gr, 0.9; high compressive strength; insoluble; some resilience. Used for packing, thermal insulation, and vibration absorption.

Cork sheet; vegetable bark in sheet form for stamping and cutting into parts. Corrosion-resistant; flexible; heat resistant to 180 F; low moisture absorption; sp gr, 0.27; fair compressive strength; resilient. Used for seals, vibration absorption.

VICTORITE (Fiber-base sheet)—Victor Mfg. & Gasket Co., Chicago.

Vegetable-fiber base sheet packing; furnished for stamping or cutting by hand into machine parts; flexible; ts, 3000 psi; heat resistant to 200 F; nonflammable; impact-resistant; sp gr, 0.675; comp str, 2000 psi; resilient. Used for gasketing and packing.

VICULOY (Beryllium copper) — The Akron Bronze and Aluminum Co., Akron, O.

No. 1; Beryllium copper sand castings, heat-treated at foundry. Ts, 85-90,000 psi; ys, 60-70,000 psi; elong in 2 in., 4-12%; Bhn, 200-220; electrical cond, 50-55; nonmagnetic; weldability, poor; abrasion resistance, medium; corrosion resistance equal to copper. For gears, pinions, flash welding dies, trolley shoes and wheels, boat shafting, welding wheels, marine hardware and fittings.

No. 2; Beryllium copper sand castings heat-treated at foundry, Ts, 45-50,000 psi; ys, 30-35,000 psi; elong in 2 in., 17-22%; Bhn, 120-140; electrical cond, 65-70; nonmagnetic; weldability, poor; abrasion resistance, high; corrosion resistance equal to copper. For circuit breaker parts, current carrying terminals, sliding contacts, burner and current collecting nozzles, spot-welding tips and wheels, etc.

No. 3; Beryllium copper sand castings heat treated at foundry. Ts, 170,000 psi; ys, 120,000 psi; elong in 2 in., 2.8%, Bhn, 370-400; electrical cond, 20-25; nonmagnetic; weldability, poor; abrasion resistance, high; corrosion resistance about same as copper. For gears, rocker arms, die molds, precision bearings and bushings, etc.

VIM (Leather)—E. F. Houghton & Co., Philadelphia 33.

For packings for hydraulically operated mechanisms. Max cont serv temp, 200 F; noninflammable; moisture absorption, low.

VIMLITE (Wire or plastics mesh re-enforced plastics)—Celanese Corp. of America, Plastics Div., New York 16.

Bursting strength (Mullen), wire, 200 psi, plastic 125-165 psi; visible light transmission, wire, 57 per cent, plastic up to 80 per cent; tough, translucent. While both are flexible, plastic mesh handles almost like fabric. Both are lightweight, will not support combustion. For machine guards, glazing, etc.

VINYLITE (Thermoplastic vinyl resins)—Bakelite Corp., New York 17.

Thermoplastic vinyl resins; material available as rigid sheets, flexible sheeting, flexible film, rigid and elastomeric molding and extrusion compounds, surface coatings, cloth coatings, textile treatments, adhesives and monofilaments. Can be formed, drawn, laminated, and bonded under moderate heat and pressure. In their basic form, they are odorless, tasteless, nontoxic, and range from nonflammable to slow burning. Some of them have exceptional resistance to moisture and most chemicals. They are strong and tough even at lower-than-freezing temperatures. They do not warp and have unusual dimensional stability.

Vinyl chloride-acetate resins both elastomeric and rigid products in many forms; vinyl acetate resins, adhesives and textile treatments; vinyl butyral resins, safety glass and cloth coatings; vinyl chloride resins, molding and extrusion compounds.

VISKORD (Thermoplastic plastics) — The Visking Corp., Terre Haute, Ind.

Vinylidene chloride type; furnished as monofilament. Abrasion resistance, medium; not affected by weak or strong acids or alkalies or organic solvents; max cont serv temp, 160-200 F; ts, 35,000-45,000 psi; produced in all colors except transparent water white; translucent; sp gr, 1.65-1.75; machinability good. Used for screen cloth and textile fabrics where chemical resistance and long life are required.

VISQUEEN (Thermoplastic plastics)—The Visking Corp., Terre Haute, Ind.

Polyethylene type; furnished in sheets and tubes; abrasion resistance, medium; not affected by strong or weak acids or alkalies, nor from organic solvents below 50 C; max cont serv temp, 212 F; flex str, 1500-1700 psi; ts, 1800-3000 psi; produced in all colors from transparent water white to black; sp gr, 0.93; machinability, good. Used as packaging material, electrical insulation for special uses.

VISTANEX MM (Thermoplastic elastomer)—Enjay Co. Inc., New York 19.

Polyisobutylene is furnished in form of pellets. Has good resistance to ozone, concentrated acids and bases; dielectric strength (volts per mil. inst.), 590; moisture absorption, low; sp gr, 0.91; is translucent; primarily used with other resins and rubbers. Combined with natural rubber or GR-S, it may be used in such products as tire treads, high-voltage electrical insulation, adhesives, steam hose, belt coverings; combines with waxes for paper coatings.

VISTEX (Rubberized laminated felt)—American Felt Co., Glenville, Conn.

Available in Hycar, Neoprene and Buna S types in sheets, strips or cut parts; for stamping and machining. Abrasion resistance, high; chemical resistance, as specified; max cont serv temp, 300 F; nonflammable; flexibility, medium; ts, 2000 psi; comp str, 10,000 psi; flexural str, high; elongation, 20 per cent; comp set, 40 per cent; moisture absorption, low; available in grey, brown, black and red; opaque. Self-lubricating positive sealing material. For hydraulic packing washers, gasketing, seals, vibration and shock mounting.

VITALIC (Mechanical rubber) — Continental Rubber Works, Erie, Pa.

Molded, extruded and lathe-cut mechanical rubber products including hose, fan belts, and all types of industrial rubber goods.

VITALLIUM (Cobalt base alloy) — Austenal Laboratories Inc., New York city and Chicago.

Precision-casting, high-strength alloy of Co 65, Cr 30, Mo 5, C 0.20-0.40. Furnished as precision castings to specifications. Untreated: Ts, 90-110,000 psi; ys, 52-85,000 psi; elong in 2 in., 5-15%; hardness Rockwell C, 20-36; nonmagnetic; weldability, good; abrasion resistance, high; resists hot or cold nitric acid; all strengths, hot exhaust gases of leaded fuels, sodium chloride, most organic acids, cold dilute hydrochloric and sulphuric acids. Max cont serv temp, 1500 F (under load). For parts requiring high strength, corrosion resistance and wear resistance at elevated temperatures.

VITREOSIL (Vitreous silica) — The Thermal Syndicate, Ltd., New York 17.

Fused silica tubing and rod in four qualities: With sand surface, glazed surface, satin surface (translucent), and transparent. The sand surface quality possesses resistance to the highest degree to extreme chemical and thermal conditions. Glazed surface material is preferable to sand surface tubing under vacuum or other conditions where a high degree of impermeability is required. Transparent material is highly transparent to ultraviolet light as well as to visible and to infra-red radiation. It is also stronger mechanically and highly impermeable, thus is used where vacuum tightness is required in sealed apparatus. All types are chemically and catalytically inert, offer high resistance to extreme thermal shock, unusual electrical resistivity, excellent thermal conductivity. Rods can be produced to special cross sectional shapes.

VITRIC-10 (Ceramic nonplastics) — United States Stoneware Co., Akron 9.

Furnished in powder form for casting into parts or as complete parts; corrosion and heat-resistant (1000 F); noninflammable. Available in colors; used for cementing and sealing.

VIX-SYN (Synthetic rubber)—E. F. Houghton & Co., Philadelphia 33.

Synthetic rubber, fabricated and homogeneous, in special molded shapes. Moisture absorption, low; opaque. For packings for hydraulically operated machines.

VOLTRON (Thermoplastic plastics)—Industrial Synthetics Corp., Garwood, N. J.

Polyvinyl chloride base thermoplastic; furnished in strips, rods or tubes; abrasion resistance, high; chemical resistance, high to all inorganic acids and most other chemicals except ketones, esters, aromatic and chlorinated hydrocarbons; max cont serv temp, 158-194 F; self-extinguishing; flexibility, high; dielectric str, 1-2000 volts per mil; ts, 1900-3000 psi (varying with different grades); elongation, 330-435; moisture absorption, low; available in clear, white, black, yellow, red, blue and green; transparent, translucent and opaque; sp gr, 1.19-1.25; shatterproof. For electrical insulation.

V-R (Cemented carbides) — Vascoloy-Ramet Corp., Waukegan, Ill.

Furnished as blended powders, separate unblended powder, and as pressed and sintered parts. Twenty grades available of tungsten-carbide bonded with various amounts of cobalt, with or without addition of tantalum and/or tungsten-titanium carbide. Transverse rupture str, 180,000-325,000 psi; Rockwell A hardness 75-93; sp gr, 10.7 to 15.2; abrasion resistance, very high. For machinery parts requiring extreme hardness and wear resistance.

VULCABESTON (Rubber-asbestos base material)—Colt's Mfg. Co., Hartford, Conn.

Crude and synthetic rubber and asbestos base, thermosetting. Furnished in sheet and laminated forms or rods and tubes for machining into parts or supplied as complete parts; heat resistant to 750 F; ts, 7000 psi; dielectric str, 40 volts per mil; corrosion-resistant; low moisture absorption. Uses include insulation, brake linings, packings, gaskets, etc.

VULCOID (Thermoplastic plastics)—Continental-Diamond Fibre Co., Newark 23, Del.

Aniline formaldehyde and cellulose hydrate base thermoplastics; furnished in sheets, rods and tubes for forming into parts. Abrasion resistance, high; max cont serv temp, 230 F; flexural str, 23,000 psi (ASTM D-229-42); dielectric str 450 volts per mil; ts, 12,000 psi; comp str 36,000 psi; impact str, 5.0 ft-lb (Izod); available in dark tan; moisture absorption, low; sp gr, 1.1-1.35; opaque; good machinability. For electrical insulation.

VYCOR (Glasses)—Corning Glass Works, Corning, N. Y.

In general, glasses with coefficient of expansion less than 20 x 10^{-7}/°C. Blown, drawn, pressed products with wide range of chemical, physical, optical, electrical and mechanical properties.

W

W-30 (Powder metal)—Powdered Metal Products Corp. of America, 9335 W. Belmont Ave., Franklin Park, Ill.

Contains 90% iron powder and 10% copper powder; ts, as pressed and sintered, 34,500 psi; ys, 27,000 psi; imp str (Izod), 2 ft-lb; Rockwell hardness, B 66; abrasion resistance, high; for gears, bushings, pawls, etc.

W-55-a (Powder metal)—Powdered Metal Products Corp. of America, Franklin Park, Ill.

High copper content; furnished in pressed and sintered parts to specification; ts, 21,000 psi; imp str (Izod), 3 ft-lb; Rockwell hardness, H 70; abrasion resistance, medium; for thrust washers, bearings, etc.

W-56 (Powder metals)—Powdered Metal Products Corp. of America, Franklin Park, Ill.

Pressed and sintered parts of leaded bronze powder metal. Ts, 25,000 psi; impact str (Izod), 3 ft-lb; hardness, Rockwell H 70; machinability, good. Is self lubricating; used for gears, bearings, bushings, etc.

W-58 (Powder metal)—Powdered Metal Products Corp. of America, Franklin Park, Ill.

Pressed and sintered parts of powder metal composition containing 99% iron and 1% carbon. Ts, 16,000 psi; hardness, Rockwell B 30; machinability, fair. Used for gears, bearings, cams, etc.

WAUKESHA Metals (Copper-nickel alloys) — Waukesha Foundry Co., Waukesha, Wis.

Copper-base, high-nickel content alloys, available in 20 different grades; furnished as sand castings for machining into parts. Ts, up to 105,000 psi; elong in 2 in., from less than 1 to 34%; hardness, brinell (3000 kg), from 93 to 264; resist corrosion caused by dairy, food, beverage and canning products, and salt solutions. For all parts contacting dairy, food, beverage and cannery foods.

WEAR-ARC (Hard facing electrodes)—Alloy rods Co., York, Pa.

Hard surfacing electrodes which impart high impact strength and good abrasion resistance.

WEIRALEAD (Ductile sheets) — Weirton Steel Co., Weirton, W. Va.

Excellent welding characteristics. Its tight, hot-dipped coating serves as a die lubricant and takes deep drawing successfully. It also provides a satisfactory base for paint, lacquer or varnish.

WEIRZIN (Zinc-coated sheets and strip)—Weirton Steel Co., Weirton, W. Va.

Sheets 32½ in. wide (available in coils or cut lengths) down to ⅝-in. strip. Adaptable to a wide variety of uses where the protection of a zinc coated material is required. This material is a high quality ductile steel with bonded coating, for deep drawing.

WELBRONCO (Nonferrous castings)—Wellman Bronze & Aluminum Co., Cleveland.

Copper-base, aluminum and magnesium sand castings to specifications.

WELD-ARC (Welding electrodes)—Alloy Rods Co., York, Pa.

Electrodes for welding mild steels, high carbon, high sulphur and low alloy, high tensile steels.

WELDRAWN (Welded tubing)—Superior Tube Co., Norristown, Pa.

Cold-drawn to give properties of seamless. Available in certain grades of stainless, beryllium copper, and in nickel and Monel.

WELDWOOD (Resin-bonded plywood) — United States Plywood Corp., New York.

Phenol-formaldehyde and urea-formaldehyde resin-bonded plywood; thermosetting; flexibility varies with thickness; splitproof; shatterproof; high tensile and dielectric strength. Obtainable in waterproof and water-resistant grades in all woods. Also available in molded shapes, tubular and curved.

WELLCAST (Nonferrous castings) — Wellman Bronze & Aluminum Co., Cleveland.

Copper-base, aluminum and magnesium sand castings to specifications.

WEL-MET (Powder metals)—The Wel-Met Co., Kent, O.

Sintered iron; Fe 90, Cu 10; furnished in rough bars and billets, plate, powder metal and in finished parts. Ts, 25,000 psi; comp str, 30,000 psi; bhn, 50; sp gr, 6.0; weldability, good; resists corrosion caused by alkalies; max cont serv temp 300 F as bearing, and 1500 F as machine parts. For self-lubricating bearings and machine parts.

Sintered bronze; Cu 85, Sn 8 and Pb 5; furnished in rough bars or billets, plate, powder metal and in finished bushings or machine parts. Ts, 10,000 psi; comp str, 12,500 psi; elong in 2 in., 5%; bhn, 35; sp gr, 60; nonmagnetic; weldability, good; resists corrosion caused by acids in concentrations normally occurring such as mine water; max cont serv temp, as lubricated, 300 F; abrasion resistance, low. For self-lubricating bushings, filter and other applications where controlled porosity is required.

WESTERN (Copper-base alloys)—Western Brass Mills Div. of Olin Industries Inc., East Alton, Ill.

Copper-base alloys (Western Brass, Western Copper, Western Super-X Phosphor Bronze, Western Super-X Nickel Silver); furnished in straight and coiled strip and sheet; for machining, hot and cold working, stamping, drawing, arc, gas and resistance welding, and brazing. Good electrical properties.

WESTFELT (Felt material) — Western Felt Works, Chicago.

Furnished in cut shapes according to user's specifications for vibration dampening, deadening sound, insulating against heat and cold and filtering liquids, air and gases; also as oil or dust seals for bearings.

WILCO (Contact and thermostatic metals)—H. A. Wilson Co., Newark 5, N. J.

Contact materials: Silver, tungsten, sintered powder metal, platinum, and alloys. Also thermostatic bimetal for all temperature ranges, deflection rates and electrical resistivities, and silver-clad steel-jacketed wire, or silver on copper, Invar or other combinations requested.

WILMINGTON FIBRE (Fiber)—Wilmington Fibre Specialty Co., Wilmington 99, Del.

Cotton rag and paper, chemically treated, nonplastic material; furnished in sheet form or rods and tubes for machining or stamping into parts; dielectric str, 200-400 volts per mil; ts, 12-15,000 psi; resistant to shock and corrosion; high polish; available in colors. Used for electrical and mechanical insulation.

WOLVERINE (Nonferrous tubing) — Wolverine Tube Div., Calumet & Hecla Consolidated Copper Co., Detroit.

Aluminum brass: Cu 76, Zn 22, Al 2; furnished in tubing. Corrosion-resistant; medium abrasion-resistant; ts, 52-100,000 psi. For bushings, condenser tubing, etc.

Phosphorized admiralty brass; Cu 70, Zn 29, Sn 1; furnished in tubing. Medium abrasion resistance; ts, 58-90,000 psi. For condenser tubing.

Arsenical Admiralty brass; Cu 70, Zn 29, Sn 1, P 0.015 max, As 0.1 max; furnished in tubing. Corrosion-resistant. For condenser tubing.

Cartridge brass: Cu 70, Zn 30; furnished in tubing. Corrosion-resistant; medium abrasion-resistance; ts, 48-88,000 psi. Used for condenser tubing, commercial tubing and pipe.

Red brass: Cu 85, Zn 15; furnished in tubing. Corrosion-resistant; medium abrasion resistance; ts, 40-69,000 psi; high ductility. For condenser tubing.

Low-Leaded brass: Cu 66, Pb 0.80 max, Zn balance; furnished in tubing. Corrosion resistant; medium abrasion resistance; ts, 48-85,000 psi. For cupped, formed or drawn parts, etc.

Copper, oxygen-free: Cu and Ag 99.9 min, P 0.015-0.035 (optional as deoxidizer); furnished in tubing. Corrosion-resistant; ts, 31-60,000 psi; high ductility. For condensers, evaporators, heaters, etc.

Cupro-Nickel: Cu 70, Ni 30; furnished in tubing. Corrosion-resistant; medium abrasion resistance; ts, 65-110,000 psi. For condenser tubing.

Copper, arsenical: Cu and Ag 99.2 min; P 0.015-0.035, As 0.15-0.50; balance is the same as oxygen-free copper.

Commercial bronze: Cu 90, Zn 10; furnished in tubing. Corrosion-resistant; available in color; medium abrasive resistance; ts, 36-63,000 psi; high ductility. For ornamental purposes.

High Leaded brass (2 & 1): free turning; Cu 66, Pb 1.75, Zn balance; furnished in tubing. Corrosion-resistant; medium abrasion resistance ts, 45-85,000 psi; machinability, good. For screw machine parts and fabricated parts.

Muntz metal; Cu 60, Zn 40; furnished in tubing. Corrosion and abrasion resistant; ts, 48-85,000 psi. For condenser tubes, etc.

Aluminum 2S; Al 99; furnished in tubing. Ductility, high; ts, 13-24,000 psi; machinability, poor. Used for airplane parts, oil burners, etc., where light weight is important.

Aluminum 3S; Al 97, Mn 1.25; furnished in tubing. Ductility, good; ts, 16-29,000 psi; machinability, good. Used for airplane parts, oil burners, etc.

WOODEX (Wood)—Neveroil Bearing Co., Wakefield, Mass.

Impregnated rock maple furnished in parts which can be machined; heat resistant to 100 F; inflammable; can be highly polished. For bearing surfaces in textile, road building, agricultural, tobacco and many other types of machinery.

WOODITE (Molded wood)—Syracuse Ornamental Co. Inc., Syracuse, N. Y.

Thermoplastic, furnished as molded parts. Abrasion resistance, low; flexibility, low; opaque. For nameplates, decorative parts.

WORCESTER (Wire)—Worcester Wire Works, Division of National Standard Co., Worcester, Mass.

Steel wire in small diameter sizes, down to 0.006-in., low and high carbon content. Annealed, hard drawn, tempered, bright, lacquer finish, tinned, copper coated, cadmium coated and galvanized.

WORTHITE (Alloy Steel)—Worthington Pump & Machinery Corp., Harrison, N. J.

Ni 24, Cr 20, Mo 3, Si 3.5, C 0.07 max. Cu 1.75, Mn 0.6, Fe, bal; furnished in finished rods or bars and as sand and centrifugal castings for turning, boring, welding, etc. Corrosion-resistant; high resistance to most acid slurries; ts, 85,000 psi, hot rolled, 70,000 psi, sand cast; medium ductility; sp gr, 7.85; bhn, 145-190 hot-rolled, 140-175 sand cast. Used for pumping equipment, valves, pipe fittings and special apparatus for corrosion resistance.

WYCKOFF (Cold finished steels)—Wyckoff Steel Co., Pittsburgh.

Controlled carbon and alloy steels; turned, polished, ground and polished shafting; annealed, strain and stress relieved, heat-treated, quenched and tempered steels; wide flats up to 12 x 2 in.

WYNENE (Plastics resin) — National Plastic Products Co., Odenton, Md.

Thermoplastic, nontoxic resin. When extruded offers lightness, flexibility, and resistance to moisture and chemicals. Available in neutral translucent and red, brown, tan, navy, royal blue, yellow, kelly green, nile green, black and white. Suitable for electrical insulation and as a protective coating for wires of all types.

X

XALOY (Iron-Nickel-Boron alloy) — Industrial Research Laboratory, Ltd., Los Angeles 11, Calif.

Furnished in the form of sand castings, plate and rod. Requires no heat treatment. Ts, 43,100 psi; comp str, 225,000 psi; ys, 42,000 psi; hardness, Rockwell C62-C68; sp gr, 7.58; machinability, poor; weldability, good; abrasion resistance, high. Is used for liners and plungers in oilwell pumps, liners and bushings for plastic and rubber extruders, drill guides, etc.

Xaloy-306: Ni, Co, Cr, Mo alloy cast to shape; requires no heat treatment. Ts, 45,000 psi; comp str, 200,000 psi; ys, 44,000 psi; impact str, low; hardness, Rockwell C50; machinability, fair; is resistant to hydrochloric acid; abrasion resistance, high. A lining material for cylinders, applied by special process. Used for extruder cylinders

for plastic extruding machines working with Saran and similar materials.

X-CREPE (Thermosetting plastics) — Cincinnati Industries, Inc., Cincinnati 15.

Phenol formaldehyde, thermosetting; furnished in rolls, sheets, die cut and coiled; also preforms for compression molding and laminating. Abrasion resistance, medium, resists action of mild acid and alkaline solutions; flexural str, 13,000-15,000 psi (ASTM D 650-42T); dielectric str, 300-400 volts per mil; ts 9200-12,000; comp str, 23,000-38,000 psi; imp str, 1.0-4.5 ft-lb (Izod); available black, brown and dark colors; sp gr 1.45; opaque; machinability, fair. For structural or functional parts where properties of phenolics are desirable.

XLO (Music spring wire)—Johnson Steel & Wire Co., Worcester, Mass.

High carbon steel wire conforming to SAE 1090 and 1095. In cold-worked state: Ts, 250-450,000 psi; ys, 95% of ts; elong in 2 in., approximately 2%; machinability, poor; weldability, good; is magnetic. Used for mechanical springs and wire forms.

Y

YOLOY (Nickel steel)—Youngstown Sheet & Tube Co., Youngstown, O.

C 0.05-0.40, Mn 0.3-1.0, Ni 0.75-0.375, Cu 0.40-1.75; special service alloy steel furnished in rough bars or billets, finished rods or bars, tubing, sheets, coiled strip, and plates, for hot forging, stamping extruding and welding. In untreated state: Ts, 70,000 psi and up, depending on carbon and manganese content; ys, 50,000 psi min; impact resistance, high; weldability, excellent; good machinability.

Z

Z-70 (Powder metal)—Powdered Metal Products Corp. of America, Franklin Park, Ill.

Contains 99% iron powder; furnished in pressed and sintered parts to specification; ts, as pressed and sintered, 70,000 psi; ys, as pressed and sintered, 63,000 psi; imp str (Izod), 3 ft-lb; Rockwell hardness, C 55; abrasion resistance, high; is self lubricating, has high resistance to wear. For ratchets, cams, valves, gears, etc.

ZAMAK (Zinc die casting alloys)—New Jersey Zinc Co., New York.

No. 3; Al 4.1, Mg 0.04, remainder Horse Head Special zinc.

No. 5; Al 4.1, Cu 1.0, Mg 0.04, remainder Horse Head Special zinc.

ZILLOY (Rolled zinc alloy)—The New Jersey Zinc Co., New York.

Contains approximately 1% copper. Furnished in sheets and strip for forming and stamping.

ZINCGRIP (Galvanized sheet iron and steel)—Armco Steel Corp., Middletown, O.

In strip or coils, with unusual forming and drawing qualities; for use wherever severe forming makes ordinary galvanized sheet metal unsatisfactory. Also supplied with a Paintgrip treatment.

Hot and cold-rolled steels; obtainable in ARMCO ingot iron, copper-bearing steel and varying analyses of medium and low carbon steel. Available in sheet form; for severe forming requirements.

Long ternes; lead-in, hot-dip coated sheets with ingot iron, mild steel, or base metal. For deep drawing requirements and paintability.

Spiral-welded pipe, in wall thicknesses of 7/64 to ½ inch, diameters 6 to 36 inches and lengths up to 50 feet; supplied mill coated, galvanized or bituminous coated and lined. Available in standard or prefabricated fittings.

ZIRCITE 1400 (Ceramic)—Stupakoff Ceramic & Mfg. Co., Latrobe, Pa.

Furnished in rods and tubes. Abrasion resistance, high; chemical resistance, good; max cont serv temp, 2200 F; noninflammable; flexibility, high; dielectric str, 160 volts per mil; ts, 9000 psi; comp str, 80,000 psi; flexural str, 20,000 psi; moisture absorption, low; opaque; shatterproof; sp gr, 0.315. For use where high chemical, heat and impact resistance are required.

ZIRMET (Zirconium metal)—Foote Mineral Co., Inc., Philadelphia 44.

Ductile zirconium metal 99+%, furnished in rough bars or billets, finished rods or bars, wire and sheet; for machining, cold working, stamping, drawing and resistance welding. In heat-treated state: Ts, 40,000 psi; sp gr, 6.5; nonmagnetic; machinability, good. For acid-resistant or alkali-resistant parts, also vacuum tube elements.

Z-METAL (Spheroidized pearlitic malleable iron)—Z-Metals, Inc., New York 17.

C 2.0-2.5, Mn 0.7-0.9, S 0.08, P 0.12-0.15, plus Mo, Cu in some. Furnished as sand castings. Can be hardened in salt bath, and can be flame hardened. In heat-treated state: ts, 75,000-95,000 psi; ys, 50,000-60,000 psi; elong in 2 in., 8-18%; Izod impact, 8-10 ft-lb; Bhn, 170-210; magnetic; weldability, poor; readily brazed; max cont serv temp, 1000 F; abrasion resistance, high. Good machinability. Used for cranks, levers, gears, power link chain, pump parts, etc.

Standard Stainless Steels

Standard AISI types are listed numerically along with analyses and brief data on properties, characteristics and representative machine applications

(Stainless steel tradenames, producers, and types and forms produced are listed on following page)

Type 301; Cr 18, Ni 8 (18-8 type) austenitic, hardenable by cold work only; ts, 80-270,-000 psi; ys, 30-240,000 psi; elong in 2 in., 40-5%. Furnished in rods, bars, billets, wire, sheet, plate, strip and tubing. For parts requiring good corrosion resistance combined with high tensile strength and good ductility.

Type 302; Cr 18, Ni 8 (18-8 type) austenitic, hardenable by cold work only, ts, 80-250,-000 psi; ys, 30-225,000 psi; elong in 2 in., 60-5%; fair machinability; excellent cold forming and welding properties. Furnished in sheet, strip, plate, bar, rod, forging billets and tube rounds, tubing, cold drawn shapes and structural shapes. For parts in acid handling, food and dairy equipment. Shafting, bearing plates, heat exchanger tubes, hydraulic tubing, piston rods, plungers, etc.

Type 303; Cr 18, Ni 8 (18-8 type) austenitic, hardenable by cold work only; ts, 80-200,-000 psi; ys, 30-135,000 psi; elong in 2 in., 55-10%; good machinability; fair cold forming and welding properties. Furnished in sheet, strip, plate, bar, rod, forging billets, tube rounds, tubing, cold drawn shapes and structural shapes. For working parts in pumps and valves which must resist corrosion. For screw machine parts requiring strength plus good corrosion resistance.

Type 304; Cr 18, Ni 8 (18-8 type), austenitic, hardenable by cold work only; ts, 85-250,-000 psi; ys, 30-225,000 psi; elong in 2 in., 60-5%; slightly better corrosion resistance than Type 302. Furnished in rods, bars, billets, wire, sheet, plate, strip, tubing and castings. For parts in chemical equipment such as shafting, bearing plates, heat exchanger tubes, etc.

Type 308; Cr 20, Ni 10 (20-10 type), austenitic, hardenable by cold work only; ts, 80-200,000 psi; ys, 30-175,000 psi; elong in 2 in., 80-55%. Furnished in sheet, strip, plate, bar, rod, forging billets, tube rounds, tubing, cold drawn shapes, structural shapes and castings. For parts in chemical equipment; shafting, bearing plates, etc. Also welding rods.

Type 309; Cr 25, Ni 12 (25-12 type) austenitic, hardenable by cold work only; ts, 95-190,-000 psi; ys, 45-165,000 psi; elong in 2 in., 50-5%; resists scaling to 2000 F, fair machinability, good cold forming properties and excellent weldability. Furnished in sheet, strip, plate, bar, rod, forging billets, tube rounds, tubing, cold drawn shapes and structural shapes. For parts that must operate continuously at high temperatures. Oil burner parts, furnace parts, heat exchangers, air heaters, baffle plates, etc.

Type 310; Cr 25, Ni 20 (25-20 type), austenitic, hardenable by cold work only; ts annealed, 70-155,000 psi; ys, 30-140,000 psi; elong in 2 in., 55-5%; good weldability, drawing and stamping properties; fair machinability. Furnished in sheet, strip, plate, bar, rod, forging billets, tube rounds, tubing, cold drawn shapes and structural shapes. For parts subject to intermittent heating and cooling. Oil burner parts, heat exchangers, dye house, paper mill and chemical plant equipment.

Type 316; Cr 18, Ni 12, Mo 3, (18-12-3 type) austenitic, hardenable by cold work only; ts, 80-170,000 psi; ys, 35-150,000 psi; elong in 2 in., 55-5%; fair machinability, excellent welding and cold forming properties. Best creep strength at high temp and best corrosion resistance of all grades. Furnished in sheet, strip, plate, bar, rod, forgign billets, tube rounds, tubing, cold drawn shapes and structural shapes. For parts requiring high corrosion resistance and high creep strength at elevated temperatures.

Type 317; Cr 18, Ni 12, Mo 4, (18-12-4 type) austenitic, hardenable by cold work only; ts, 80-170,000 psi; ys, 35-150,000 psi; elong in 2 in., 60-40% (annealed). Furnished in sheet, strip, plate, bar, rod, forging billets, tube rounds, tubing, cold drawn shapes, structural shapes, castings. For parts for equipment in paper industry; shafts, bearing plates, piston rods, etc.

Type 321; Cr 18, Ni 8, Ti 4 x C min; austenitic, hardenable by cold work only; ts, 80-170,000 psi; ys, 30-145,000 psi; elong in 2 in., 55-5%; fair machinability, excellent welding and cold forming properties. Furnished in sheet, strip, plate, bar, rod, forging billets, tube rounds, tubing, cold drawn shapes and structural shapes. For welded parts not annealed after welding or which operate at 800-1200 F. Aircraft engine exhaust rings, flanges, etc.

Type 347; Cr 18, Ni 8, Cb 8 x C min; austenitic, hardenable by cold work only; ts, 80-170,000 psi; ys, 30-150,000 psi; elong in 2 in., 50-5%; fair machinability, excellent welding and cold forming properties. Furnished in sheet, strip, plate, bar, rod, forging billets, tube rounds, tubing, cold drawn shapes and structural shapes. For welded parts not annealed after welding or which operate at 800-1200 F. Aircraft engine exhaust rings, flanges, etc.

Type 403; Cr 12 (straight chromium type) hardenable by heat treatment; ts, 100,000; elong in 2 in., 30%; bhn, 202-241; high impact resistance and elastic limit. Furnished in bar stock and wire. For parts in turbine construction; steam turbine blades.

Type 405; Cr 12, Al 0.1-0.3 (12-Al type), not appreciably hardenable by heat heatment; ts, 60-75,000 psi; ys, 35-50,000 psi; elong in 2 in., 40-20%; is non-air-hardening. Furnished in sheet, strip, plate, bar, rod, forging billets, tube rounds, tubing, cold drawn shapes, structural shapes and castings. For parts requiring welding, annealing boxes, quenching racks, oxidation-resistant partitions.

Type 410; Cr 12 (straight chromium type), hardenable by heat treatment; ts, 60-180,-000 psi; ys, 30-160,000 psi; elong in 2 in., 30-15%; good machinability and cold forming properties, good welding properties when annealed. Most popular forging grade of stainless. Furnished in sheet, strip, plate, bar, rod, forging billets, tube rounds, tubing, cold drawn shapes and structural shapes. Used where corrosion is not severe, for bolts, nuts, shafting, turbine blading, valve trim and heat treated parts where hardness and toughness are desired.

Type 414; Cr 12, Ni 2, (12-2 type), hardenable by heat treatment; magnetic; ts, 119,-000 psi (approx); ys, 94,000 psi (approx); elong in 2 in., 25% (approx); good corrosion resistance. Furnished in sheet, strip, plate, bar, rod, forging billets, tube rounds, tubing, cold drawn shapes and structural shapes. Knife blades, tempered rules, straight edges, scraper knives, mild springs, etc. Parts requiring better corrosion resistance and higher strength than Type 410.

Type 416; Cr 12, (straight chromium type with sulphur or selenium added); excellent machinability; ts, 70-170,000 psi; ys, 40-140,000 psi; elong in 2 in., 30-10%; fair cold forming properties, fair corrosion resistance. Furnished in bar, rod, forging billets, wire, cold drawn shapes. For mass production machined parts. Carburetor, instrument and electrical parts. Excellent for screw machine parts.

Type 420 and 420F; Cr 13, C 0.35 (straight chromium type) highly hardenable by heat treatment; ts, 95-250,000 psi; ys, 60-200,-000 psi; elong in 2 in., 30-5%; fair machinability and cold forming properties; good corrosion resistance. Type 420 F is free machining. Furnished in sheet, strip, plate, bar, rod, forging billets, tube rounds, tubing, cold drawn shapes, and structural shapes. Generally used for hard, keen, knife edges for cutlery and surgical instruments.

Type 430; Cr 17 (straight chromium type), nonhardenable by heat treatment; resists scaling to 1500 F; excellent cold heading porperties, excellent machinability, does not discolor in atmosphere. Ts, 60-85,000 psi; ys, 35-55,000 psi; elong in 2 in., 35-20%. Furnished in sheet, strip, plate, bar, rod, forging billets, tube rounds, tubing, cold drawn shapes and structural shapes. For press plates, oil burner parts, screw machine parts, trim for automobiles such as body moldings, hub caps, finishing washers, gas tank caps, etc. Also trim for appliances.

Type 430F; Cr 17 with 0.07 S or Se; (straight chromium free machining type), nonhardenable by heat treatment; ts, 60-85,000 psi; ys, 35-55,000 psi; elong in 2 in., 25-10%; excellent machinability, fair cold forming properties. Furnished in forging billets, hot-rolled and cold-finished bars, wire and polished shafting. Particularly suitable for parts requiring considerable machining and which need only moderate corrosion resistance. Screw machine parts.

Type 431; Cr 16; Ni 2; (straight chromium type), hardenable by heat treatment; ts, 110-200,000 psi; ys, 80-150,000 psi; elong in 2 in., 20-15%; good machinability; fair cold forming properties; resists scaling to 1500 F. Best corrosion resistance of all hardenable stainless steels. Furnished in sheet, strip, plate, bar, rod, forging billets, tube rounds, tubing, cold drawn shapes, structural shapes. For parts requiring excellent physical properties coupled with high corrosion resistance.

Type 440 C and 440 A, B and F; Cr 17; C 1.00 (straight chromium type), hardenable by heat treatment; ts, 110-285,000 psi; ys, 60-275,000 psi; elong in 2 in., 15-2%; fair machinability and cold forming properties. Types A and B are of same analysis except for lower carbon content, thus are less hardenable. Type F is free machining. Furnished in sheet, strip, plate, bar, rod, forging billets, tube rounds, tubing, cold drawn shapes, structural shapes. Needle valves, ball check valves, ball bearings, scissors, rules, cutlery, etc.

Type 442; Cr 20, Cu 1; hardenable by cold work only; magnetic; annealed, approx properties are: Ts, 90,000 psi; ys, 50,000 psi; elong in 2 in., 22%. Resists scaling to 1600 F. Furnished in sheet, strip, plate, bar, rod, forging billets, tube rounds, tubing, cold drawn shapes, and structural shapes. Scale resistant parts such as in furnaces, soot blower tubes, stirring rods and ladles for molten nonferrous metals.

Type 446; Cr 27 (straight chromium type), nonhardenable by heat treatment; ts, 75-85,000 psi; ys, 45-60,000 psi; elong in 2 in., 35-20%; resists scaling to 2000 F; corrosion resistance equal to 18-8. Furnished in sheet, strip, plate, bar, rod, forging billets, tube rounds, tubing, cold drawn shapes, structural shapes. For parts requiring moderate strength when operating at high temperatures. Valves and fittings, baffle plates, heaters, oil burner parts, etc.

Types 501 and 502; Cr 4-6, Type 501 has over 0.10 C; Type 502 has 0.10 C max. Otherwise analyses identical. Hardenable by heat treatment; magnetic; ts, 60,000 psi min; ys, 25,000 psi min; elong in 2 in., 30% min. Heat and corrosion resistance between that of plain steels and the high chromium and chromium-nickel steels. Furnished in sheet, strip, plate, bar, rod, forging billets, tube rounds, tubing, cold drawn shapes, structural shapes. For parts in high temp service; oil refinery and chemical equipment.

Stainless Steels—Tradenames and Producers

Tradenames of stainless steels are listed alphabetically along with names of producing companies, and standard AISI types and forms produced

(For data on analyses, characteristics, properties, and representative machine applications, see Page 281)

ALLEGHENY METALS — Allegheny Ludlum Steel Corp., Breckenridge, Pa.
Types 301, 302, 303A, 303C, 303S, 304, 305, 308, 309, 310, 314, 316, 317, 321, 347, 403, 405, 410, 414, 416, 418, 420, 430, 431, 440A, 440C, 446, 501, 501 plus Mo, 502, 502 plus Mo. All types produced in the form of bars, sheets, strip, plate, shapes, forgings, castings, and wire.

ALMET—Alloy Metal Wire Co. Inc., Prospect Park, Pa.
Types 302, 304 and 420 in the form of wire, rod and strip. Types 303, 308, 309, 310, 316, 317, 321, 347, 410, 416, 430, 442, and 446 in the form of wire and rod.

ARMCO—Armco Steel Corp., Middletown, O.
Types 302, 304, 304ELC, 308, 316, 316ELC, 321, 347, 410 and 430 in the form of bar, wire, sheet, strip, plate and angles.
Type 301 in the form of bar, wire, sheet, strip and angles.
Types 309 and 446 in the form of bar, wire, sheet, strip and plate.
Types 405, 414, 420, 431, and 442 in the form of bar, wire and angles.
Types 303, 310, 416, 420F, 430F, 440A, 440B, 440C, 440F, 501, and 502 in the form of bar and wire.
Type 403 in the form of bar.

B & W CROLOY—Babcock & Wilcox Tube Co., Beaver Falls, Pa.
Types 302, 302B, 304, 308, 309, 310, 316, 317, 321, 347, 405, 410, 414, 420, 430, 440C, 446, 501, 501 with Mo, 502, and 502 with Mo.

BETHADUR—Bethlehem Steel Vo., Bethlehem, Pa.
Types 302, 304, 308, 309, 310, 316, 317, 321, 347, 403, 410, 414, 420, 430, 431, 440A, 440B, 440C, 442, 446, 501, and 502 in the form of bars and billets.

BETHALON—Bethlehem Steel Co., Bethlehem, Pa.
Types 303 and 416 in the form of bars and billets.

CARPENTER—The Carpenter Steel Co., Reading, Pa.
Types 302, 303, 304, 308, 309, 310, 316, 317, 321, 329, 347, 403, 405, 406, 410, 414, 416, 420, 420F, 430, 430F, 431, 440A, 440B, 440C, 440FM, 442, 443, and 446 in the form of bars, billets, wire and strip.

ENDURO—Alloy Steel Division, Republic Steel Corp., Massillon, O.
Types 301, 302, 302B, 303, 304, 305, 308, 309, 309S, 310, 316, 317, 321, 347, 403, 410, 414, 416, 420, 420F, 430, 430F, 431, 440, 442, 446, 501 and 502 in the form of pig or ingot, rough bars or billets, finished rods and bars, coil and straight strip, tubing, wire, sheet, and plate.

ES—Eastern Stainless Steel Corp., Baltimore 3, Md.
Types 301, 302, 302B, 304, 304ELC, 309, 310, 316, 305, 321, and 347 in the form of sheet and plate.

GLOBE—Globe Steel Tubes Co., Milwaukee.
Types 304, 316, 321, 347, 410, 430, 446, 501, and 502 in the from of seamless tubing.

GLOWELD—Globe Steel Tubes Co., Milwaukee.
Types 301, 302, 304, 308, 309, 310, 316, 317, 321, 347, 403, 405, 410, 430, and 446 in the from of welded tubing.

INGERSOLL—Ingersoll Steel & Disc Div., Borg-Warner Corp., Chicago.
Types 302, 304, 316, 317, 347, and 430 in the form of sheet and plate and 18-8 stainless clad sheet and plate from No. 18 gage to ¼-inch.
Types 309, 310, 410, 446, 501, and 502 in the form of sheet and plate.

JESSOP—Jessop Steel Co., Washington, Pa.
Types 301, 302, 303, 304, 308, 310, 316, 317, 321, 347, 403, 405, 410, 416, 420, 420F, 440F, 440A, 440B, 440C, 440F, 430, 430F, 442, 446, 501 and 502.

MISCO METAL—Michigan Steel Casting Co., Detroit 7, Mich.
Types 330, 430, 310 and 309.

REZISTAL—Crucible Steel Co. of America, New York.
Type 301 in the form of bar, sheet, plate, hot and cold-rolled strip, and wire.
Types 302, 302B, 303, 304, 311, 314, 325, 403, 405, 414, 420 in the form of bar, sheet, plate, hot and cold-rolled strip, wire, forgings and precision castings.
Types 347F, 420F, 430F, 431, and 440F in the form of forgings.
Type 305 in the form of bar, sheet, plate, hot and cold-rolled strip.
Types 308 and 309 in the form of bar, sheet, plate, hot and cold-rolled strip, wire and electrodes.
Types 310, 410 and 318 in the form of bar, sheet, plate, hot and cold-rolled strip, wire, forgings and precision castings.
Types 316, 317, 330 and 347 in the form of bar, sheet, plate, hot and cold-rolled strip, wire, forgings, precision castings and electrodes.
Type 321 in the form of bar, sheet, plate, hot and cold-rolled strip, and wire.
Type 416 in the form of bar, sheet, plate, forgings and precision castings.
Types 430, 442, 446, 501 and 502 in the form of bar, sheet, plate, hot and cold-rolled strip, wire, forgings and electrodes.
Types 440A, 440B and 440C in the form of bar, sheet, plate, hot and cold-rolled strip, wire and forgings.

SHARON—Sharon Steel Corp., Sharon, Pa.
Types 301, 302, 302B, 303, 304, 308, 309, 310, 316, 317, 321, 347, 403, 405, 406, 410, 414, 416, 420, 420F, 431, 440A, 440B, 440C, 440F, 430, 430F, 442, 443, 446, 501 and 502.

STERLING—Firth Sterling Steel & Carbide Corp., McKeesport, Pa.
Types 301, 302, 303, 308, 309, 403, 405, 414, 416, 420, 420F, 430, 430F, 431, 440A, 440B, 440C, 440F, 442, and 446 in the form of billets, bar, forgings, hot-rolled coil, cold-drawn rod, centerless-ground bar, and cold-drawn wire.
Types 304, 310, 316, 317, 321, 347, and 410 in the above forms plus tube rounds.

STERMET—Sterling Alloys Inc., Woburn, Mass.
Types 302, 303, 309, 310, 312, 316, 327, 330, and 347.

SUPERIOR—Superior Steel Corp., Carnegie, Pa.
Types 301, 302, 304, 305, 310, 316, 321, 347, 410, 414, 420, 430, 440A, 440B, 440C, and 446 in the form of hot and cold-rolled strip.

TIMKEN—Timken Steel & Tube Div., Timken roller Bearing Co., Canton 6, O.
Types 301, 302, 303, 304, 308, 309, 310, 316, 317, 321, 347, 405, 410, 414, 416, 420, 420F, 431, 440A, 440B, 440C, 440F, 430, 430F, 442, 501, 502.

U. S. S. STAINLESS—American Steel & Wire Co., Cleveland.
Types 301, 302, 303, 304, 308, 309, 310, 314, 316, 317, 321, 347, 403, 405, 410, 416, 430, 446, 501, 502.

Index of Materials by Type

This cross-reference index provides a key between alloying constituents and tradenames. Tradenamed materials are indexed primarily under the base or predominating alloying element or, in some cases such as bearing metals, under the primary use. Alloying elements which control the properties of the material are arranged alphabetically as subheads under the main heads. In a few cases additional controlling elements are added in italics

(For data on analyses, characteristics, properties, and representative machine applications, see Page 225)

IRON & STEEL

Carbon Steels

Acipco
Agaloy
Ajax
Aristoloy
Bethlehem
Bethloc
Birdsboro
Buffalo
Bundyweld
Calstrip
Commonwealth
Continental
Cumberland
Dodge
Eclipse
Economo 17
Elastuf JJ
Elastuf Media
Electrunite
Esco
Expanded Metal
Farrell
Follansbee
Globe
Hylastic
Ideal Electric Steel
Inland
Jalcase
J & L
Keystone
Kidd
Laminum
Michigan
Midvale
Midvaloy
Nikoh
Page
Pittsburgh
Planet
Pompton
PSF
Red Anchor
Rockrite
S-G
Sharon
Speed Case
Speed-Treat
Standard
Strain-Tempered
Superior
Tesco
Thinsteel
Timken
Ti-Namel
Ultra-Cut
U.S.S.
U.S.S. Amercut
U.S.S. American Quality
U.S.S. Shelby
XLO

Chromium Steels

Acipco
Agaloy
Allegheny Metals
Almet
Armco
Bethadur
Bethalon
Bethlehem
Buffalo
B & W Croloy
Carpenter
Chemalloy
Circle L
Cooper Alloys
Eclipse
Eis 45
Elastuf (*Ni, Mo*)
Electrunite
Esco
Expanded Metal
Globe
Gloweld
Hotform
Hylastic
Ingersoll
Kidd
Kleenkut
Lo-Cro
Micro-rold
Midvale
Midvaloy
Ohmaloy (*Al*)
Page
Peterson
Red Cut Superior (*C*)
Rezistal
Rockrite
Sealmet
Sharon
Sterling
Superior No. 3
Superior
Teton
Thermalloy HC 250
Thinsteel
Timken
Weldrawn
U.S.S. Carilloy
U.S.S. Cor-Ten
U.S.S. Shelby
U.S.S. Stainless
Trentweld

Chromium-Molybdenum Steels

Amsco
Atlas No. 93
Bescoloy
Bethlehem
B & W Croloy
Circle L
Continental
DM
DM-45 (*Si*)
Elastuf Chro-moly
Globe
Nitralloy
Pressuredie No. 2 (*W*)
Pyrasteel (*Si*)
Shell Die (*Si*)
Sicromo (*Si*)
Worthite

Chromium-Molybdenum-Nickel Steels

Bethlehem
Calite
Chlorimet No. 3
Continental
Cuprodie
Durimet 20
Durite
Durodi
Eis 57
Elastuf 44
Fahralloy
Finkl
Heppenstall
Hy-Ten
Lukens
Tisco

Chromium-Manganese Steels

Armacast
Bethlehem
Circle L
Hy-Ten
Lukens
Nurex
PSI
Tisco (*Mo*)
T.R.S.

Chromium-Nickel Steels

Accoloy
Acipco
Agaloy
Allegheny Metals
Almet
Armco
Bescoloy
Bethadur
Bethalon
Bethlehem
Buffalo
B & W Croloy
Calite
Carpenter
Chemalloy
Chromax
Chromel
Cimet
Circle L
Continental
Cooper Alloys
Durco
Eclipse
Elastuf (*Mo*)
Electrunite
Esco
Evansteel
Expanded Metal
Fahralloy
Globe
Gloweld
Hylastic
Ingersoll
Kidd
Lo-Cro
Lukens
Mayari R
Michiana
Micro-rold
Midvale
Page
Par
Pioneer
Pyrasteel (*Si*)
Republic Cor-Ten
Rezistal
Sharon
Sterling
Superior
Thermalloy
Thinsteel
Timken
Trentweld
U.S.S. Carilloy
U.S.S. Shelby
U.S.S. Stainless
Weldrawn

Chromium-Vanadium-Tungsten Steels

Bethlehem
Gold Anchor
Marvel
Seminole Hard

Copper Steels

Beth-cu-loy
Bethlehem

Manganese Steels

Amsco
Carcometal
Circle L
Esco
Kidd
La-Sulphite 8640
Lukens (*V*)
Max-el
Neloy
Silver Star
Stressproof
Strong No. 18
Timken
Tisco
Tritex No. 2
U.S.S. AR steel
U.S.S. Carilloy
U.S.S. Man-Ten
Univan C

Manganese-Molybdenum Steels

Bethlehem
Circle L
Continental
Deward
Dodge
Hy-Ten
Lukens
MM
Moly-Telastic
Neloy
Pitaloy

Manganese-Nickel Steels

Allegheny Ludlum
Bethlehem
Resistress (*V*)
Tisco
U.S.S. Mang-Ni-Cu
Univan

Manganese-Silicon Steels
- Allegheny Grade 609
- Bethlehem
- Blue Anchor
- Carpenter
- Colonial
- Graph M.N.S. *(Ni)*

Molybdenum Steels
- Bethlehem
- Circle L
- Lukens
- Red Streak
- Republic Aldecor

Molybdenum-Nickel Steels
- Bethlehem
- Chlorimet No. 3
- Circle L
- Continental
- Finkl
- Molybdenum Permalloy *(Fe)*
- Monimax
- Republic Double Strength
- Tigerloy

Nickel Steels
- Allegheny Ludlum
- Bethlehem
- Carpenter
- Chromel
- Dodge
- Kidd
- Lukens
- Nicloy
- Nikro *(Cr)*
- Nilvar
- Sharon
- Timken
- Tioga
- U.S.S. Carilloy

Silicon Steels
- Allegheny Ludlum
- Armco
- Bethlehem
- Durichlor *(Mo)*
- Duriron
- Eclipse
- Graph-Sil
- Mosil
- Silman
- Silmo *(Mo)*
- T-Loys *(Mo)*

Other Alloy Steels
- Chrome-Vanadium
- Commonwealth
- Electrunite
- Globe
- Graph-Mo
- Graph-Tung
- Ideal Electric Steel
- Keystone
- Midvale
- Par-Exc
- Pittsburgh
- Planet
- PSF
- Python
- Rayduct
- Rigidized Metal
- Sharon
- Thinsteel
- T-Loys
- Trantinyl
- U-Loy
- U.S.S. Amercut
- U.S.S. American Quality
- U.S.S. Carilloy
- U.S.S. Premier
- Vanadium Permendur

Alloy Cast Irons
- Acipco
- Afcoloy
- Afiron
- Belectric
- Carcoloy
- Eleverite
- Hitest
- Hunt-Spiller
- Iralite
- Jefaloy
- Littite
- Ni Hard
- Ni Resist
- Ni Tensyliron
- Sorbo-Mat
- Tuftest

Malleable Irons
- Belectromal
- Belmalloy
- Ermal Z-Metal
- Mallix
- Perduro
- Promal
- Shockproof
- Supermal
- Z-Metal

Special Steels (not otherwise specified)
- Acme Strip
- Adamantine
- Ammonoduct
- Anchor
- AW
- AW Dynalloy
- Beth-co-weld
- Bethtelductor
- Binney
- Birdsboro
- B & W 5202
- Chemalloy N Series
- Colorstrip
- Commercial
- Congo
- Dynalloy
- Elastuf Penn
- Esco
- Farrell
- Fivepoint Deephard
- Graph-Al
- Hi-Steel
- Isocast
- Jalloy
- Kidd
- Lukens
- Machempite
- Max-el
- Michigan
- Mo-Max
- Mumetal
- Naco
- National
- N-A-X
- Otiscoloy
- Timken

Irons
- Armco
- Byers Genuine
- Crasfloy
- Cromonite
- Ermalite
- Falls
- Frankite
- Globeiron
- Hiperco *(Co)*
- Hipersil *(Si)*
- Hytemco
- Jewell
- Mayari
- Meehanite
- Shenango-Penn
- Silvery Mayari
- Toncan
- Xaloy

ALUMINUM BASE

- Alclad
- Alcoa
- Allcast No. 60
- Apex
- Cemco
- Doler Alsiloy No. 1
- Doler Alsiloy No. 9
- Doler Alsiloy No. 10
- Do-Lite
- Expanded Metal
- General
- Hytenat
- Isocast
- Kaiser Aluminum
- Lectro-Pat
- Nemaloy
- Permite
- Permold
- Planet
- Precision
- Precision
- Red-X
- Reynolds
- Silvercote
- Ternalloy
- Trualoy
- Utica
- Welbronco
- Wellcast
- Wolverine

BEARING METALS

Babbitt
- Adamant Super-Genuine
- Defender
- Dutch Boy
- Glacier
- Glyco
- Grac
- Graphalloy
- Hoyt
- Mogul
- National
- Pitt
- Power Nickel Genuine

Other Bearing Metals
- Agricola
- Anfriloy
- Bearium Metals
- Bound Brook
- Bunting
- Compo
- Federal
- Graphalloy
- Idealoy
- Johnson
- Ledaloyl
- Lumen Alloys
- Magnolia
- Mueller 600
- National
- Oilite
- Powdiron
- Promet
- Pyramid
- Sabeco
- Satco
- Sandusky
- Selflube

BIMETALS

- Chace
- Wilco

BISMUTH BASE

- Cerrobase
- Cerrobend
- Cerrolow-117
- Cerromatrix
- Cerrotru

BONDED OR PLATED

- Allegheny Metal Stainless Clad
- Apollo
- Colorstrip
- Copperweld
- Ingaclad
- Makepeace
- Ni Clad
- Ornamet
- Paintgrip
- Permaclad
- Platinum Clad
- Plymet
- Rosslyn Metal
- Silvercote
- Superior
- Suveneer
- Weiralead
- Weirzin
- Zincgrip

COBALT BASE

- Alnico *(Al, Ni)*
- Cunico *(Co)*
- Haynes Stellite
- Redhard NF
- Tantung
- Tisco
- Vectolite *(Fe)*
- Vitallium

COPPER BASE

High Copper
- Ampco Metal
- Bridgeport
- Chase Tellurium Copper
- Cupaloy
- Eclipse
- Hussey
- Revere

Copper-Aluminum
- Ampco Metal
- Ampcoloy
- Aur-o-met
- Avialite
- Everdur *(Si)*
- Frontier
- Molin Metal
- Resistaloy *(Ni)*
- Revere *(Si)*
- Tempaloy *(Ni)*
- Titan *(Si)*

Copper-Aluminum-Iron
- Ampcoloy
- Resistac
- Trualoy
- Tuf-Stuff-224E

Copper-Beryllium
- Berylco
- Conduloy
- Silvercote
- Weldrawn

Copper-Lead-Zinc
- Bridgeport
- Scovill

Copper-Nickel
- Adnic
- Advance
- Ambrac
- Ampco Metal
- Anaconda
- Bridgeport
- Cunife *(Fe)*
- Dairywhite
- Excelsior
- Frontier
- LMC
- Phosnic
- Scovill
- Telnic Bronze
- Ti-Nic-O-Sil *(Zn)*
- Waukesha Metals
- Wolverine

Copper-Silicon
- Bridgeport
- Duronze Alloys
- Everdur *(Mn)*
- Herculoy *(Sn or Mn)*

Copper-Tin
- Ampco Metal
- Bearium Metals
- Bridgeport
- Frontier
- Harris 80-10-10
- Scovill
- Seymour

Tiger *(Pb)*
Trualoy *(Pb)*

Copper-Tin-Zinc
Anaconda
Bridgeport
Chamet
Scovill
Shook Alloy 664
Trembronze
Titan
Tobin

Copper-Zinc
Aeterna 600
Ampco Metal
Anaconda
Bridgeport
Chase *(Pb)*
Hecla
Hi-Ten-Si-Loy
Hy-Ten-Si *(Al, Mn, Fe)*
Logan
Oreide *(Sn)*
Revere *(Ni)*
Scovill
Seymour *(Ni)*
Tombasil *(Si)*
Trualoy *(Al, Fe)*
Wolverine *(Al)*

Other Copper Alloys
Alpro
Ampcoloy
Buffalo
Chase
Doler-Brass
Elephant Brand
Elkonite
Expanded Metal
Laminum
Lektromesh
LMC
Mallory
Moccasin
Precision
Randall
Revere
Rigidized Metal
Sandusky
Shenango-Penn
Silvercote
Superior
Tru-Con
Welbronco
Wellcast

WELDING AND HARD-FACING ELECTRODES, BRAZING COMPOUNDS AND SOLDERS

Abrasoweld
Aerisweld
Agile
Airco
Aladdin Rod
All-State
Aluminweld
Ampco-Trode
Amsco
APW
Arcaloy
Arcos
Borod
Bronzochrom
Cerroseal
Colmonoy
Crescent
Cromansil
Cupro-Arc
Cutrode
Dieweld
Easy-Flo
Economy Hardface
Elkaloy
Eureka
Eutecrod
Eutechrom
Eutectic
Eutectofilm
Eutectrode
Farmface
Ferroweld
Fleetweld
Genex
Handy Flux
Hardex
Hardweld
Hascrome
Haystellite
Indium
Kwikmetal
Laternex
Lenk Super Aluminum Solder
Machine-Face
Magic Plastic Body Solder
Manganal
Manganweld
Mang-Co
Marquette
Metal & Thermit
Moiex
Mo-Mang
Nickel-Arc
Nicromol
Ni-Hard
Orrweld
Oxweld
Oxycuttend
Pal-Weld
Penn
Phos-Copper
Railface
Resistwear
Rexarc
River RS Brand
Rotometals
Rubyfluid
Shield-Arc
Shober
Sil-Fos
S-M-S Alloys
Softweld
Solderall
Stainweld
Stoodite
Stoody
Stoody Self-Hardening
Stoody Tube Borium
Temdco
Titan
Tool-Arc
Toolface
Toolweld
Tri-Core
Trindle Speedweld
Trodaloy
Tube Tungsite
Tungrod
Unimetal
Vertex
Wear-Arc
Weld-Arc

MAGNESIUM BASE

Apex
Doler-Mag
Dowmetal
M-13
Mazlo
Utica
Welbronco
Wellcast

NICKEL BASE

Agaloy
Alray
Buffalo
Bundyweld
Conpernik
Cooper Alloys
Eclipse
Expanded Metal
Hastelloy
Hipernik *(Fe)*
Illium G
Inconel
Invar
K-42-B
Kovar
Lektromesh
Michiana
Monel
Nichrome-Nichrome V
Nickel
Ni-Span *(Ti, Cr)*
Precision
Sandusky
Shenango-Penn
Superior
Weldrawn
Xaloy-306

POWDER METALS

B-50
Carboloy
Crowley
E-1 to E-15
E-70
F-10 to F-80
Gempco
Gibsiloy
Gramix
Hardy
Hardyne
Hevimet
Ledaloyi
Magicores
MD
MRCO
New Jersey Zinc
Oilite
Plast-Iron
Plast-Manganese
Plast-Nickel
Plast-Silicon
Plast-Sponge
Plast-Steel
Powdiron
Powmetco
Sinteel
Stackpole
V-R
W-30
W-55-a
W-56
W-58
Wel-Met
Wilco
Z-70

PLATINUM BASE

Baker
Elkonium
Ney-Oro-G
Paliney *(Pb)*
Wilco

SILVER BASE

Elkonite
Elkonium
Silmanal *(Mn, Al)*
Wilco

TUNGSTEN BASE

Firthaloy
Firthite
High Density Alloy 112
Kennametal
Mallory
MCA
Talide
V-R
Wilco
Zirmet

ZINC BASE

Apex
Doler-Zink
Eraydo Alloy
Illinois
Precision
Zamak
Zilloy

ZIRCONIUM BASE

Zirmet

PLASTICS, THERMOSETTING

Melamine Formaldehyde
Consoweld
Farlite
Insurok
Melmac
Micarta
Phenopreg
Plaskon

Phenolic
Baker Casting Resin
Celoron
Consoweld
Co-ro-lite
Dilecto
Durez
Durite
Farlite
Formica
Heresite
Indur
Insurok
Interlake
Intuc
Kys-ite
Lamicoid
Marblette
Mecoboard
Ohmoid
Phenolite
Plastone
Plyophen
Resinox
Ryertex
Sko-Resin
Spauldite
Synthane
Taylor Fibre
Taylor Phenol Fibre
Tego
X-Crepe

Polyvinyl Butyral
Butacite

Urea
Beetle
Insurok
Lamicoid
Plaskon
Uformite

Cold Molded
Garit
Gummon
Hemit
Tegit
Thermoplax

Other Types
Allymer
Cardolite
Cellulak
CR-39
Ebrok
Furatone
Gemloid
Glastic
Haveg 41, 48, 60
Hiden
Homalite
Kriston A
Laminac
Lamineer
Marcolite
MR
Panelyte
Reanite
Resistal
Rosite
Selectron
Shell-Pli
Valite
Vibrin
Victoprene

PLASTICS, THERMOPLASTIC

Acrylic
Gemlite

Aniline Formaldehyde
Vulcoid

Cellulose Acetate
Celanese
Chemaco
Durashield
Fibestos
Hercules
Inceloid

INDEX BY TYPE

Koppers Cellulose Acetate
Lumarith
Nixon C/A
Plastacele
Plax
Sandee
Tenite
Tulox

Cellulose Hydrate
Vulcoid

Cellulose Nitrate
Celluloid
Nitron
Nixon C/N
Pyralin

Ethyl Cellulose
Celcon
Chemaco
Ethocel
Koppers Ethyl Cellulose
Nixon E/C
Norcell
Plax
Sandee
Thermo-Cast
Tulox

Polyamide
Nylon
Polyco

Polyethylene
Jodapac
Plax
Polythene
Visqueen

Melamine
Resimene

Methyl Methacrylate
Irilite
Lucite
Plax
Plexiglas
Sandee

Polystyrene
Chemaco
Koppers Polystyrene
Lustrex
Parsan
Piccolastic
Plax
Polyflex
Sandee
Styron

Polyvinyl Acetal
Saflex

Polyvinyl Alcohol
Compar
Elvanol

Styrene
Lustron
Marbon S
Plexene
S-Polymer

Vinyl
Ace Saran
Fibron
Gemflex
Geon
Resproid
Sandee
Saran
Synflex
Syntholvar
Ultron
Viskord
Voltron

Other Types
Aquaflex
Cerex
Cliderite
Compac
Duralon
Elastron
Elvacet
Forticel
Gemloid
Hyflex
Insurok
Irilite
Irv-O-Lite XTE 30
Ivi-Flex
Joda
Koroseal
Lumite
Molex
Parian
Parnal
Resilon
Resistoflex
Teflon
Transflex
Tru-Size
Tygoflex
Tygon
Ultron
Vimlite
Vistanex MM
Wynene

ADHESIVES

Hydrocal
Hydrostone
Koppers
Magic Iron Cement
Magic Plastic Lead
Paisley
Penacolite
Pleximent
Resin X-2

ASBESTOS

Aztec
Stonewall
Terratex
Victopac
Victor

BONDING RESINS

Amberlite
Dow Corning DC 2103

CARBON & GRAPHITE

Carbocell
Graphicell
Graphitar
International
Karbate
Key
National
Ohio
Purebon
S.C.P.
St. Marys
Speer
Supergraph

CERAMICS

AlsiMag
B & W
Ceraware
Colonial
Cordierite
Crolite
Elemite
Isolantite
Lavite
Lavolain
Pinco
Shamva Mullite
Steatite
Stupakoff
Thermolain
Titanates
U. S. Standard
Usalite 1350
Vitreosil
Vitric-10
Zircite 1400

COMPOSITIONS

Aertite
Armstrong's
Celite
Cel-O-Glass
Cohrlastic
Darex
Dufelt
Eel-Slip
Elasto-Rib
Empire
Fairprene
Featherweight
Felpro
Feltan
FV
Fyberoid
Gaskofelt
Harris Silentbloc
Hy-Temp
Insulkote
Irv-O-Slot
Irv-O-Volt
Maizewood
National Switch Insulation
Razoseal
Refrasil
Resistofelt
RS
Ruberoid
Santocel
Turbo
Unisorb
Vellumoid
Vellutex
Vistex
Vulcabeston

CORKS

Armstrong's

FELTS

American
Booth
Felters
K
Westfelt

FIBERS

Armstrong's
Brandywine
Centraline
Diamond
Fabroil
National Fibre
Peerless
Penn
Spaulding Armite
Spaulding Fibre
Spauldo
Victorite
Wilmington Fibre

GLASSES

Blue Ridge
Carrara
Corning
Duolite
Duplate
Electrapane
Fiberglas
Flexseal
Herculite
KGI
LOF
Multiplate
Pennvernon
Pittsburgh
Polaroid
Pyrex
Safetee
Thermopane
Tuf-Flex
Twindow
Vycor

LEATHERS

Graton & Knight Leathers
Korry-Krome
Vim

MICA

Micabond
Micanite
Mycalex

REFRACTORIES

Blazecrete
Firecrete

RUBBERS

Acadia
Ace
Ajax
Ameripol
Armstrong's
Butaprene
Butyl
Cell-Tite
Conservo
G-E
Grakone
Hycar
Johnson
Lord
Luzerne
Maltese Cross
Monarch
Neoprene
Orco
Perbunan
Rub-Erok
Silastic
Spongex
Tensilastic
Texfoam
Thiokol
Tyer
U. S. Rubber
Victolene
Vitalic
Vix-Syn

VARNISHES

Dow Corning DC 993 and DC 996
Harvel
Indur
Irvington

WOODS

American
Armorply
Benelex 70
Densewood
Dens-Tech
Die-Tech
Farlite Compreg
Fybr-Tech
Haskelite
Mesh-Tech
Pamudo
Pearl City
Phemaloid
Pluswood
Plymold
Ply-Tech
Preg-Tech
Presdwood
Resnprest
Sweet Home Brand
Syrocowood
Weldwood
Woodite

Materials Producers

Names of producing companies are listed alphabetically along with types of materials produced and their tradenames

(For data on properties, characteristics and typical uses of these tradenamed materials, see Page 225)

A

Acme Steel Co., 2840 Archer Avenue, Chicago 8, Ill.
Colored strip steel—COLORSTRIP
Strip steel—ACME STRIP

The Advance Foundry Co., 107 Seminary Ave., Dayton, Ohio.
Alloyed high strength cast gray iron — STRENES C

Agaloy Tubing Co., Springfield, O.
Carbon steel, alloy steel, stainless steel, Monel, Inconel, nickel and composite tubing—AGALOY

Air Reduction Sales Co., 60 E. 42nd St., New York 17.
Welding electrodes and gas welding rods—AIRCO

Ajax Metal Co., 46 Richmond St., Philadelphia 23, Pa.
Copper-base alloys—TOMBASIL

The Akron Bronze & Aluminum Co., Box 1086, Akron 9, O.
Beryllium-copper sand castings—VICULOY

Aladdin Rod & Flux Mfg. Co., Box 935, Madison Square Sta., Grand Rapids 7, Mich.
Welding and brazing rod—ALADDIN ROD

Allegheny Ludlum Steel Corp., Brackenridge, Pa.
Stainless steels—ALLEGHENY METALS
Special alloy tool steels—ATLAS No. 93, PYTHON, SEMINOLE HARD, TETON, TIOGO
Nondeforming tool steel—DEWARD
Carbon tool steel—POMPTON
Electrical steels—ALLEGHENY LUDLUM, MONIMAX, VANADIUM, PERMENDUR, MOLYBDENUM PERMALLOY, MU-METAL, OHMALOY and SEALMET.
Mild and stainless steel—ALLEGHENY METAL, STAINLESS CLAD
Silicon-Manganese steels — ALLEGHENY GRADE 609

Alloy Casting Co., Champaign, Ill.
Stainless steel castings—ACCOLOY

Alloy Metal Wire Co., Moore's Station, Prospect Park, Pa.
Stainless steels—ALMET
Electrical resistance alloy wire—ALRAY A, ALRAY C, ALRAY D, EXCELSIOR
Nickel clad copper wire—NI CLAD

Alloy Rods Co., York, Pa.
Welding electrodes—ARCALOY, NICKEL-ARC, CUPRO-ARC, TOOL-ARC, WEAR-ARC and WELD-ARC

Alloys Development Co., Pittsburgh, Pa.
Alloy steels—ALDECOR

Alloys & Products Inc., Oak Point Ave. & Barry St., New York 59.
Nonferrous alloys—ALPRO

All-State Welding Alloys Co. Inc., 96 West Post Rd., White Plains, N. Y.
Welding and brazing rods and solders—ALL-STATE

Alpha Metals, Inc., 363 Hudson Ave., Brooklyn 1, N. Y.
Rosin filled solder—TRI-CORE

Aluminum Co. of America, 801 Gulf Bldg., Pittsburgh.
Aluminum alloys—ALCOA and ALCLAD

Aluminum Industries Inc., Cincinnati.
Aluminum-base alloy castings—PERMITE

Amalgamated Steel Corp., 7835 Broadway, Cleveland, O.
Tool steel—T.R.S.

American Agile Corp., 5806 Hough Ave., Cleveland 3, Ohio.
Welding electrodes—AGILE

American Brass Co., Waterbury, Conn.
Copper-aluminum alloy—AVIALITE
Copper-aluminum and nickel alloy— TEMPALOY
Copper-base alloys—AMBRAC, TOBIN BRONZE, ANACONDA, EVERDUR

American Cast Iron Pipe Co., 2930 N. 16th St., Birmingham 2, Ala.
Cast irons and steels—ACIPCO

American Cladmetals Co., P. O. Box 544, Carnegie, Pa.
Clad metal—ROSSLYN METAL

American Crucible Products Co., 1301 Oberlin Ave., Lorain, O.
Bearing bronzes—PROMET

American Cyanamid Co., Plastics Div., 30 Rockefeller Plaza, New York 20.
Urea-formaldehyde plastics—BEETLE
Melamine-formaldehyde plastics—MELMAC
Unsaturated polyester resin—LAMINAC

American Electro Metal Corp., 320 Yonkers Ave., Yonkers 2, N. J.
Steel powder-metal parts—SINTEEL

American Felt Co., Glenville, Conn.
Felt material—"K" FELT and AMERICAN FELT
Rubberized and press laminated felt—VISTEX
Rubberized felt—FELTAN

American Hard Rubber Co., 11 Mercer St., New York 13.
Hard rubbers—ACE
Plastics—PARIAN, ACE SARAN, PARNAL, PARSAN

American Lava Corp., 219 Kruesi Bldg., Chattanooga 5, Tenn.
Ceramics—AlSiMag

American Magnesium Corp., 2210 Harvard Ave., Cleveland.
Magnesium alloys—MAZLO

American Manganese Bronze Co., Holmesburg, Philadelphia 36, Pa.
Aluminum bronzes—RESISTAC
Aluminum manganese bronzes—HY-TEN-SL

American Manganese Steel Div. of American Brake Shoe Co., 389 E. 14th St., Chicago Heights, Ill.
Alloy steel castings—AMSCO
Welding rods — DIEWELD, ECONOMY HARDFACE, FARMFACE, MACHINE-FACE, MANG-MO, MO-MANG, NI-HARD, RAILFACE, RESISTWEAR, TOOLFACE, TUNGROD, and TUBE TUNGSITE

American Nickeloid Co., 23 Second St., Peru, Ill.
Prefinished bonded-sheet and strip — NICKELOID, CHROMALOID, BRASSOID; AMERICAN Bonded Metals, and Copper steel

American Plastic Corp., 225 W. 43th St., New York 1.
Casein thermoplastic—AMEROID

American Platinum Works, The, Newark, N. J.
Silver brazing alloys and fluxes, fine, coin and sterling silver, platinum metals and their alloys—APW

American Plywood Corp., New London, Wis.
Phenolic urea plywood—AMERICAN PLYWOOD

American Products Mfg. Co., Oleander and Dublin Sts., New Orleans.
Cellulose derivative thermoplastic — INCELOID

American Smelting & Refining Co., Equitable Bldg., New York.
Cadmium-nickel bearing alloy—ASARCOLOY No. 7.
Lead-bearing alloy—"G" ALLOY

American Steel Foundries, Industrial Div., 410 N. Michigan Ave., Chicago 11.
Cast steels—HYLASTIC

American Steel & Wire Co., Rockefeller Bldg., Cleveland.
Carbon steels and alloys—U. S. S. AMERICAN QUALITY
Cold-finished steel bars—U. S. S. AMERCUT
High-strength steels—U. S. S. COR-TEN
Stainless steels—U. S. S. STAINLESS
Spring steel—U. S. S. PREMIER

American Wringer Co. Inc., Woonsocket, R. I.
Rubber and rubber synthetics—TENSILASTIC

Ampco Metal Inc., 1745 So. 38th Street, Milwaukee 4.
Corrosion, shock and wear-resistant alloys—AMPCO METAL
Coated welding rods—AMPCO-TRODE
Copper-base alloys—AMPCOLOY

Anchor Drawn Steel Co., Latrobe, Pa.
High-carbon steel drill rod—RED ANCHOR, BLUE ANCHOR, GOLD ANCHOR and ANCHOR Carbon-Vanadium

Apex Smelting Co., 6700 Grant Ave., Cleveland 5, and 2537 W. Taylor St., Chicago 12.
Aluminum casting alloys—ALLCAST No. 60, TERNALLOY, and RED X
Aluminum, zinc and magnesium alloys—APEX

Apollo Metal Works, 6605 South Oak Park Ave., Chicago 38.
Prefinished cold-rolled steel—APOLLO

Arcos Corp., 1500 S. 50th St., Philadelphia 43.
Stainless arc-welding electrodes—ARCOS
Arc-oxygen cutting rods—OXYCUTTING

Armco Steel Corp., Middletown, O.
Stainless and thin-gage stainless steel strip —ARMCO
Galvanized sheet iron or steel—ZINCGRIP and PAINTGRIP
Medium silicon electrical steels—TRAN-COR

Armstrong Cork Co., Lancaster, Pa.
Cork composition, cork-and rubber compositions, synthetic rubber compounds, fiber sheet packings, rag felt papers, and cork-and-synthetic-rubber compositions—ARMSTRONG'S

Athenia Steel Co., Div. of National Standard Co., Clifton, N. J.
High-carbon steels—ATHENIA Steel

Atlantic Foundry Co., The, 182 Beaver St., Akron 4, O.
Iron castings—AFCOLOY METAL

Atomized Materials Co. Inc., MD-200 Magee Bldg., Pittsburgh 22.
Liquid solder—KWIKMETAL

Aurora Metal Co., 614 W. Park Ave., Aurora, Ill.
Aluminum bronze die castings—AUR-O-MET

Austenal Laboratories Inc., New York City and Chicago.
Precision-casting high-strength alloy — VITALLIUM

B

B & S Bronze Foundry, Inc., 39-17 22nd St., Long Island City 1, N. Y.
Aluminum castings—HYTENAT

The Babcock & Wilcox Co., 85 Liberty St., New York 6, N. Y.
Wear resisting cast steels and cast iron—ADAMANTINE, ELVERITE and B & W 5202

Babcock & Wilcox Co., The, Refractories Div., 85 Liberty St., New York 6.
Firebrick—B & W Firebrick

Babcock & Wilcox Tube Co., The, Beaver Falls, Pa.
Steel tubes—NICLOY
Steel tubing—B & W CROLOY

Bakelite Corp., 30 E. 42nd St., New York 17.
Phenolic, urea, cast resin plastics, and polystyrene plastics—BAKELITE
Vinyl chloride-acetate, vinyl acetate and vinyl butyral resins and plastics—VINYLITE

Baker & Co. Inc., 113 Astor St., Newark 5, N. J.
Platinum, palladium, gold, silver and their alloys—BAKER and PLATINUM-CLAD

Baker Oil Tools, Inc., Box 2274, Terminal Annex, Los Angeles 54.
Plastics resin—BAKER CASTING RESIN

Bearium Metals Corp., 266 State St., Rochester, N. Y.
Bearing bronzes—BEARIUM METALS

Belle City Malleable Iron Co., Racine, Wis.
Pearlitic malleable iron—BELMALLOY
High-strength malleable iron—BELECTROMAL
Electric-furnace-melted cast iron—BELECTRIC

Bendix Aviation Corp., Metal Hose Dept., Teterboro, N. J.
Seamless flexible metal hose—ECLIPSE and BENDIX

The Beryllium Corp., Reading, Pa.
Beryllium coppers—BERYLCO 10, BERYLCO 10C, BERYLCO 20C, BERYLCO 25S, BERYLCO 275C

Bethlehem Steel Co., Bethlehem, Pa.
Butt-welded steel pipe—AMMONODUCT, BETH-CO-WELD and RAYDUCT
Stainless steels—BETHADUR and BETHALON
Zinc-coated steel wire—BETHANIZED
Copper-steel sheets—BETH-CU-LOY
Tin plate—BETH-CO-LITE
High tensile steel wire—BETHTELDUCTOR, RURALDUCTOR
Low alloy, high-strength steel—MAYARI R
Spring steel—SILVER STAR
Steel and steel products—BETHLEHEM
Steel wire—BETHCO
Steel plate—BETHLOC
Pig iron—MAYARI, SILVERY MAYARI
Wire rope—PURPLE STRAND

Binney Castings Co., 2555 Dorr St., Toledo 7, O.
Heat-resisting castings—MIN-OX, BINNEY METAL and BINNEY NO. 71 and NO. 73.

Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.
Steel castings—BIRDSBORO

Ernst Bischoff Co. Inc., Plastics Div., Ivoryton, Conn.
Thermoplastic tooling materials—THERMOCAST
Thermoplastic potting materials — CLIDERITE

Bliss & Laughlin Inc., Buffalo, N. Y.; Harvey, Ill.; Mansfield, Mass.
High sulphur bessemer screw stock — ULTRA-CUT
Cold finished steels — STRAIN-TEMPERED

Bohn Aluminum & Brass Corp., Lafayette Bldg., Detroit.
Light-aluminum alloy—BOHNALITE

H. Boker & Co., Inc., 101 Duane St., New York 7, N. Y.
Tool steel—INTRA, KINITE
Die steel—OILWAY
High-speed steel—NOVO SUPERIOR

The Bonney Floyd Co., Columbus 7, O.
Steel castings—MM

Booth Felt Co., 444 19th St., Brooklyn, N. Y.
Wool base felt—BOOTH

The Borden Co., Chemical Division, 5000 Summerdale Ave., Philadelphia 24, Pa.
Phenol-formaldehyde and phenol-furfural plastics—DURITE

Bound Brook Oil-Less Bearing Co., Bound Brook, N. J.
Bearing bronzes—BOUND BROOK and COMPO
Porous iron bearing alloys—POWDIRON

L. S. Brach Mfg. Corp., 200 Central Ave., Newark, N. J.
Solder in paste form—SOLDERALL

Braeburn Alloy Steel Corp., Braeburn, Pa.
High abrasion and high tensile strength alloy steels—PRESSUREDIE No. 2 and SUPERIOR No. 3
High speed tool steel—CONGO

Brake Shoe & Casting Div., American Brake Shoe Co., 230 Park Ave., New York.
Ni-Cr alloy steel castings—ABK metal

William Brand & Company, 276 Fourth Ave., New York 10.
Varnished insulating material—TURBO

Brandywine Fiber Products Co., 15th and Poplar Sts., Wilmington, Del.
Vulcanized fiber, phenol fiber, paper and canvas-base material—BRANDYWINE

Bridgeport Brass Co., Bridgeport, Conn., and Indianapolis, Ind.
High-copper silicon bronzes—DURONZE
Copper and zinc alloys—BRIDGEPORT
Tubing—BRIDGEPORT

Brighton Electric Steel Casting Co., Beaver Falls, Pa.
Alloy steel castings—BESCOLOY

The Brush Beryllium Co., 4301 Perkins Ave., Cleveland 3, Ohio.
Beryllium coppers—CONDULOY and No. 6

Buchsbaum & Co., S., 1737 So. Michigan, Chicago 16.
Vinylidene chloride and vinyl chloride acetate copolymers—ELASTI-GLAS

Buffalo Wire Works Co., Inc., 430 Terrace, Buffalo.
Wire cloth—BUFFALO

Buflovak Equipment Div., Blaw-Knox Co., 15 Filmore Ave., Buffalo 11, N. Y.
Alloy cast iron—BUFLOKAST

Bundy Tubing Co., 8109 E. Jefferson, Detroit.
Tubing of steel, Monel, and "L" nickel—BUNDYWELD

Bunting Brass & Bronze Co., 715 Spencer St., Toledo 9, O.
Bearing bronzes—BUNTING

Burgess-Parr Co., Freeport, Ill.
Cast nickel alloy—ILLIUM G

Byers Co., A. M., Clark Bldg., Pittsburgh 30.
Wrought iron—BYERS

C

Cadman, A. W., Mfg. Co., 2816 Smallman St., Pittsburgh.
Nickel-bronze alloy—NICUITE
Babbitt metals—BEARITE and ACORN

California Cold Rolled Steel Corp., 7140 Telegraph Rd., Los Angeles 22, Calif.
Low-carbon cold-rolled strip steel—CALSTRIP

Callite Tungsten Corp., Union City, N. J.
High tungsten alloy—HIGH DENSITY ALLOY 112

Calorizing Co., 400 Hill Ave., Wilkinsburg, Pittsburgh, Pa.
Heat-resisting cast steels—CALITE

Cambridge Wire Cloth Co., Cambridge, Md.
Wire cloth—CAMBRIDGE

Carboloy Co., Inc., 11177 East 8-Mile Rd., Detroit.
Cemented carbides—CARBOLOY

Carnegie-Illinois Steel Corp., Carnegie Bldg., Pittsburgh.
Abrasion resisting steels—U.S.S. AR STEEL
Alloy steels—U.S.S. CARILLOY
High strength steels — U S.S. COR-TEN, U.S.S. MANG-NI-CU steels, U.S.S. MAN-TEN
Stainless steels—U.S.S. STAINLESS
Sheet steels—U.S.S.

Carpenter Steel Co., Reading, Pa.
Stainless and specialty alloy steels—CARPENTER
Low expansion alloys—INVAR

Catalin Corp. of America, 1 Park Ave., New York.
Bonding resin—CATABOND

Celanese Corp. of America, Plastics Div., 180 Madison Ave., New York 16.
Cellulose acetate plastics—LUMARITH
Cellulose nitrate plastics—CELLULOID
Cellulose propionate thermoplastic—FORTICEL
Ethyl-cellulose thermoplastic—CELCON
Wire or plastic mesh reinforced plastic—VIMLITE
Thermoplastic laminates—CELANESE

Central Paper Co., Inc., 2400 Lakeshore Drive, Muskegon 28, Mich.
Wood-cellulose fiber material — CENTRALINE

Centrifugal Foundry Co., Muskegon, Mich.
Alloy iron castings—CENTRALLOY

Cerro de Pasco Copper Corp., 40 Wall St., New York, N. Y.
Low-melting-point alloys — CERROBASE, CERROBEND, CERROMATRIX, CER-

ROLOW, 117, CERROSAFE, CERRO-TRU
Metal-to-glass solder—CERROSEAL

Chace Co., W. M., 1616 Beard Ave., Detroit 9.
Thermostatic bimetals—CHACE

Chain Belt Co., 1643 W. Bruce St., Milwaukee 4.
High tensile, corrosion-resistant casting—REX Z METAL

Chase Brass & Copper Co., Waterbury 91, Conn.
Corrosion-resistant copper alloys—CHAMET BRONZE, CHASE TELLURIUM COPPER, and CHASE PHOSNIC BRONZE.
High tensile strength bronze—TELNIC

Chemaco Corp., Berkeley Heights, N. J.
Cellulose-acetate, ethyl-cellulose, polystyrene molding materials—CHEMACO

Chemical Research Corp., P. O. Box No. 2002, Tulsa 1, Okla.
High-strength plastics—RESISTAL

Chicago Malleable Castings Co., 1225 West 120th St., Chicago 43, Ill.
Alloy malleable castings—SUPER Y

Chicago Rawhide Mfg. Co., 1301 Elston Avenue, Chicago 22, Ill.
Synthetic rubber—SIRVENE
Mechanical leather—SIRVIS

Chicago Steel Foundry Co., Kedzie Ave. and 37th St., Chicago 32.
High tensile strength castings—EVANSTEEL and PYRASTEEL

Chicopee Mfg. Corp. of Georgia, 47 Worth St., New York, N. Y.
Industrial fabrics—LUMITE

Chrysler Corp. Amplex Div., P. O. Box 2718, Detroit 31.
Bearing bronze—OILITE
Bearing iron alloy—SUPER-OILITE
Bearing iron—IRON OILITE
Bearing iron alloy hardened—SUPER-OILITE "16"
Filter elements, porous metal—OILITE FILTERS
Friction materials, porous metal—OILITE FRICTION MATERIALS

Ciba Co. Inc., 627 Greenwich St., New York 14.
Aniline formaldehyde plastics resin—CIBANITE

Cincinnati Industries Inc., 515 Station Ave., Lockland, Cincinnati.
Phenol formaldehyde thermosetting plastic—X-CREPE Resin

Cleveland Electro Metals Co., The, 2391 W. 38th St., Cleveland 13.
Aluminum alloys—CEMCO and LECTRO-PAT

Cleveland Laboratories & Mfg. Co. Inc., Holland Ave., Peapack, N. J.
Vinyl resin coatings—CLEARSEAL

Cleveland Tungsten Inc., 10200 Meech Ave., Cleveland.
Copper-tungsten electrodes—CLETALOY
Tungsten ground seal rod — CLEVE-TUNGSTEN
Molybdenum bars, wire, sheet and powder metal—CLEVE-TUNG

Cleveland Twist Drill Co., The, 1242 East 49th St., Cleveland 14, Ohio.
High-speed steel—MO-MAX

The Climax Molybdenum Co., 500 Fifth Ave., New York 18, N. Y.
Molybdenum alloying element—MOLYBDENUM

Coast Metals, Inc., Canton, Ohio.
Hard facing alloys—COAST METALS

Cold Metal Products Co., Youngstown, Ohio.
Carbon, alloy and stainless strip steel—THINSTEEL

Colonial Insulator Co., The, 973 Grant St., Akron, O.
Ceramic material—COLONIAL

Colt's Mfg. Co., 17 Van Dyke Ave., Hartford, Conn.
Hard rubber and asbestos base material—VULCABESTON

Columbia Steel Co., Russ Bldg., San Francisco 6.
Abrasion-resisting steels—U.S.S. AR STEEL
Alloy steels—U.S.S. CARILLOY
High strength steels—U.S.S. COR-TEN, U.S.S. MAN-TEN
Sheet steels—U.S.S.
Stainless steels—U.S.S. STAINLESS
Spring steel—U.S.S. PREMIER

Columbia Steel & Shafting Co., Woodkirk St., Pittsburgh 30.
High-tensile steel—COLUMBIA

Columbian Rope Co., Auburn, N. Y.
Phenolic resin base—CO-RO-LITE

Commercial Steel Casting Co., 1205 Cheney Ave., Marion, O.
Steel castings to specification—COMMERCIAL

The Connecticut Hard Rubber Co., 407 East St., New Haven, Conn.
Silicone elastomer on fiberglas—COHRLASTIC

Consolidated Water Power & Paper Co., Wisconsin Rapids, Wis.
Thermosetting laminated plastics — CONSOWELD

Continental-Diamond Fibre Co., Newark 23, Del.
Phenolic plastics — DILECTO, CELORON, MECOBOARD and DILECTO Glass Fabric
Resinous plastics—VULCOID
Vulcanized fiber—DIAMOND
Shellac thermosetting material—CELLULAK
Mica material—MICABOND

Continental Foundry & Machine Co., East Chicago, Ind. and Pittsburgh, Pa.
Iron alloys—CROMONITE and CRASFLOY
Carbon steels and alloy steels for rolls—CONTINENTAL

Continental Rubber Works, 2000 Liberty St., Erie, Pa.
Mechanical rubber—VITALIC

Cooper Alloy Foundry Co., The, Bloy St. & Ramsey Ave., Hillside, N. J.
Metal alloy castings—COOPER ALLOYS

Copperweld Steel Co., Glassport, Pa.
Copper-covered steel—COPPERWELD
Electric furnace semifinished carbon steel—ARISTOLOY

Corning Glass Works, Corning, N. Y.
Glass materials—CORNING, PYREX and VYCOR

Crescent Smelting Works, Inc., 232 Seigel St., Brooklyn 6, N. Y.
Solder—CRESCENT

Crowley & Co., Henry L., West Orange, N. J.
Steatite and other ceramics—CROLITE
Powder iron—MAGICORES
Powder metal—CROWLEY

Crucible Steel Casting Co., Almira Ave., and W. 84th St., Cleveland.
Sand castings—PAR

Crucible Steel Co. of America, 405 Lexington Ave., New York.
High-strength alloy steel—MAXEL
Corrosion and heat-resistant alloys—LO CRO and REZISTAL

Cumberland Steel Co., 101 Williams St., Cumberland, Md.
Turned and ground steel—CUMBERLAND

Cutler-Hammer Inc., 12th & St. Paul, Milwaukee.
Cold-molding plastics—THERMOPLAX

D

Joseph Davis Plastics Co., Arlington, N. J.
Thermoplastic plastics—JODA, and JODA-PAC

Densewood Corp., The, Elkhorn, Wis.
Impregnated wood—DENSEWOOD

Detroit Gray Iron Foundry, 282 Iron St., Detroit 7, Mich.
Iron alloy casting—LEKTROKAST

Dewey & Almy Chemical Co., 62 Whittemore Ave., Cambridge 40, Mass.
Sealing compound—DAREX

Dirilyte Co. of America, Inc., 1142 S. Main St., Kokomo, Ind.
Aluminum-bronze alloys—MOLIN METAL

Doane Products Corp., The, Meriden, Conn.
Thermoplastic plastics—LOUVERPLAS

Dodge Cork Co. Inc., Manor & Laurel Sts., Lancaster, Pa.
Composition cork—DODGE

Dodge Steel Co., Tacony, Philadelphia 35.
Electric steel castings—DODGE

Doehler-Jarvis Corp., 386 Fourth Ave., New York 16, N. Y.
Copper-zinc-silicon die casting alloys—DOLER-BRASS and DOLER-ZINK
Magnesium base die casting alloys—DOLER-MAG
Aluminum base die casting alloys—DOLER-ALUMINUM, DOLER - ALSILOY #1, DOLER-ALSILOY #9, and DOLER-ALSILOY #10

The Dow Chemical Co., Midland, Mich.
Thermoplastic granules—ETHOCEL, STYRON and SARAN
Magnesium and magnesium alloys—DOW-METAL

Dow Corning Corp., Midland, Mich.
Electrical insulating varnish—DOW CORNING DC 993 and DC 996
Silicone rubbers—SILASTIC
Silicone resins—DOW CORNING DC 2103
Silicone lubricants—DOW CORNING DC 550, DC 710, DC 33, DC 41 and DC 44
Silicone compounds—DOW CORNING DC 4
Silicone fluids—DOW CORNING DC 200, DC 702 and DC 703

Driver Co., Wilbur B., Riverside Ave., Newark, N. J.
Beryllium-copper alloys—BERALOY "A"
Copper-nickel alloy—CUPRON
Nickel-chromium alloy—TOPHET

Driver-Harris Co., Harrison, N. J.
Heat and electrical resisting alloys — ADVANCE, NIREX, NILVAR, CHROMAX, CIMET, NICHROME and NICHROME V, HYTEMCO

Du Pont de Nemours, E. I., & Co. Inc., Fabrics Div., Fairfield, Conn.
Synthetic rubber coated fabrics — FAIRPRENE

Du Pont de Nemours, E. I., & Co., Inc., Wilmington, Del.
Plastic-coated wire mesh—CEL-O-GLASS
Nitrocellulose base—PYRALIN
Cellulose acetate base—PLASTACELE
Polyvinyl alcohol—ELVANOL
Polyvinyl acetate—ELVACET
Polytetrafluoroethylene—TEFLON
Polyvinyl butyral—BUTACITE

Du Pont de Nemours, E. I., & Co. Inc., Plastics Dept., Arlington, N. J.
Acrylic resin—LUCITE
Tetrafluoroethylene polymer—TEFLON
Polyamide thermoplastic—NYLON
Polyethylene thermoplastic—POLYTHENE

The Duraloy Company, Scottdale, Pa.
Chromium steel—DURALOY

Durez Plastics & Chemicals Inc., North Tonawanda, N. Y.
Phenolic plastics—DUREZ

Duriron Co., Inc., Dayton, O. (and Licensees—see Duriron in tradename listing).
Corrosion and heat-resistant alloy castings—DURICHLOR, DURIMET 20, DURIRON, DURCO and CHLORIMET.

E

Eastern Stainless Steel Corp., Baltimore 3, Md.
Stainless steel sheets—ES

Electric Steel Castings Co., Speedway, Indianapolis, Ind.
Alloy steel castings—DUC-TEN

Electric Steel Foundry Co., 2141 N. W. 25th Ave., Portland 10, Oreg.
Cast steels—ESCO

Electro-Alloys Div., American Brake Shoe Co., Elyria, O.
Ni-Cr alloy steel castings—THERMALLOY
High alloy steel castings—THERMALLOY HC 250
Stainless steel castings—CHEMALLOY
High-alloy cast iron—CHEMALLOY N SERIES

Electro Metallurgical Sales Corp., 30 East 42nd St., New York 17, N. Y.
Ferro-alloys and alloying elements—ELECTROMET

Empire Steel Castings Inc., Box 139, Reading, Pa.
Steel castings—ISOCAST

Enjay Co. Inc., 15 West 51st St., New York 19.
Nitrile rubber—PERBUNAN
Isobutylene-isoprene copolymer—BUTYL
Polyisobutylene elastomer—VISTANEX
Styrene-isobutylene copolymer—S-POLYMER

Erickson Electronic Sales Co., 1417 Seventh St., Rockford, Ill.
Welding electrodes—NICROMOL

Erie Malleable Iron Co., 621 West 12th St., Erie, Pa.
Abrasion and wear-resisting cast irons—ERMAL and ERMALITE

Eutectic Welding Alloys Corp., 40 Worth St., New York 13.
Welding alloys, cutting electrode and fluxes—BRONZOCHROM, EUTECTIC, EUTECROD, EUTECTRODE, EUTECHROM, EUTECTOFILM

Everhot Products Co., 2001-09 W. Carroll Ave., Chicago 12, Ill.
Copper-fused and copper coated steel tubing—BUNDYFLEX

Extruded Plastics Inc., Norwalk, Conn.
Thermoplastic tubing—TULOX

F

Fabricon Products Inc., 1721 W. Pleasant, River Rouge 18, Mich.
Thermosetting plastic sheet—PHENOPREG

Fahralloy Co., Harvey, Ill.
High nickel-chrome steel—FAHRALLOY

Falk Corp., The, 3001 W. Canal St., Milwaukee 8, Wis.
Alloy cast steel—MOLY-TELASTIC

Falls Hollow Staybolt Co., 7 E. Portage Trail, Cuyahoga Falls, O.
Wrought iron—FALLS

Fansteel Metallurgical Corp., North Chicago, Ill.
Corrosion-resistant, high-tensile-strength metals—FANSTEEL

Farrell-Cheek Steel Co., Sandusky, O.
Abrasion-resisting cast steels—FARRELL

Farley & Loetscher Mfg. Co., Dubuque, Iowa.
Phenolic and melamine plastics—FARLITE
Fabric base, thermosetting plastics — FARLITE

Federal Mogul Corp., 11031 Shoemaker Ave., Detroit.
Bearing bronzes—FEDERAL BRONZES
Babbitt bearing alloys—MOGUL BABBITTS

Felt Products Mfg. Co., 1508 Carroll Ave., Chicago 7.
Fiber-rubber-cork-felt material — FELPRO

The Fahralloy Co., Harvey, Ill. Mass.
Noise and vibration damping material — UNISORB
Felts—FELTERS
Felt laminated with Neoprene—DUFELT

Finkl & Sons Co., A., 2011 Southport Ave., Chicago 14.
Alloy steels—DURODI, CUPRODIE, SHELL DIE, and FINKL

Firestone Tire & Rubber Co., Akron.
Synthetic rubber—BUTAPRENE

Firth Sterling Steel & Carbide Corp., McKeesport, Pa.
Sintered carbides—FIRTHITE and FIRTHALOY
Stainless steels, and chrome-nickels—STERLING

The Fitzsimons Steel Co., 1623-31 Wilson Ave., Youngstown 8, Ohio.
Alloy steels — SPEED CASE, SPEED TREAT

Follansbee Steel Corp., Third and Liberty Aves., Pittsburgh 22, P.
Cold rolled strip steel—FOLLANSBEE

Foote Bros. Gear & Machine Corp., 4545 So. Western Blvd., Chicago 9.
Hardened special hard steel—FIVEPOINT DEEPHARD

Foote Mineral Co., Inc., 10 E. Chelten Ave., Philadelphia 44.
Ductile zirconium metal—ZIRMET

Formica Co., The, 4614 Spring Grove Ave., Cincinnati 32.
Laminated thermosetting plastics—FORMICA

Fort Pitt Steel Casting Div., McKeesport, Pa.
Alloy steel casting—TUFALOY

Frank Foundries Corp., Moline, Ill.
Corrosion and abrasion-resistant iron alloys—FRANKITE

Franklin Fibre-Lamitex Corp., 190 E. 12th St., Wilmington, Del.
Laminated phenolic plastics—LAMITEX
Hard vulcanized fiber—FRANKLIN

Frontier Bronze Corp., 818 Elmwood Ave., Niagara Falls, N. Y.
Wear-resisting bronzes—FRONTIER

Furane Plastics & Chemicals Co., 719 W. Broadway, Glendale 4, Calif.
Plastic adhesive—RESIN X-2

G

Garfield Mfg. Co., Garfield, N. J.
Thermosetting materials—GUMMON (black); HEMIT (gray-white); TEGIT (phenolic binder) and GARIT

Gatke Corp., 228 No. LaSalle St., Chicago 1.
Asbestos packing—AZTEC

Gemloid Corp., 7900 Albion Ave., Elmhurst, L. I., N. Y.
Tubing and gasketing material—GEMFLEX
Thermoplastic material—EMLOID
Acrylic thermoplastic—GEMLITE

General Ceramics & Steatic Corp., Keasbey, N. J.
Ceramic materials—CERAWARE, STEATITE, GENERAL CORDIERITE and TITANATES

General Electric Co., Chemical Dept., 1 Plastics Ave., Pittsfield, Mass.
Glass-bonded mica—G-E MYCALEX
Silicone rubbers—G-E
Permanent magnet alloys—ALNICO, CUNICO, and CUNIFE
Magnet materials—SILMANAL and VECTOLITE
Special alloy—G-E Hevimet
Silicone rubber-coated glass cloth—G-E

General Electric Co., Pittsfield, Mass.
Insulating paper—TERRATEX

General Electric Co., Schenectady, N. Y.
Resistance welding electrode—TRODALOY

General Electric Co., Electronics Dept., Syracuse, N. Y.
Special composite materials — MULTIWEAVE

General Metals Powder Co., Akron, O.
Metallic friction materials—GEMPCO

General Plastics Corp., 119 W. 57th St., New York 19.
Laminated plastics—LAMINEER

General Plate Div., Metals & Controls Corp., Attleboro, Mass.
Thermostat metals—TRUFLEX
Composite aluminum-copper—ALCUPLATE

General Steel Castings Corp., Granite City, Ill.
Steel castings—COMMONWEALTH

General Tire & Rubber Co., Mechanical Goods Div., Wabash, Ind.
Rubber—GENERAL
Composite rubber-metal material—SILENTBLOC

Gibson Electric Co., 8350 Frankstown Ave., Pittsburgh 21.
Powder metal—GIBSILOY

Glacier Metal Co., Richmond, Va.
Bearing babbitt—GLACIER

Globe Steel Tubes Co., Milwaukee 4.
Seamless steel tubing—GLOBE
High purity ingot iron—GLOBEIRON
Stainless welded tubing—GLOWELD

Goodrich, B. F., Co., Akron, O.
Synthetic elastic parts—KOROSEAL
Synthetic rubber parts—AMERIPOL

Goodrich Chemical Co., B. F., Rose Bldg., Cleveland 15.
Allyl ester, thermosetting material—KRISTON "A"
Polyvinyl chloride thermoplastic—GEON
American rubber—HYCAR

Goodyear Tire & Rubber Co., Akron, O.
Synthetic rubber—CHEMIGUM

Graphite Metallizing Corp., 1045 Nepperhan Ave., Yonkers 3, N. Y.
Carbon-graphite metallized material—GRAPHALLOY

Graphitized Alloys Corp., 5 Beekman St., New York 7.
Lead-base graphitized babbitt—GRAC

Graton & Knight Co., 356 Franklin St., Worcester 4, Mass.
Oil resistant rubber—GRAKONE
Mechanical leather—GRATON & KNIGHT LEATHER

Great Lakes Steel Corp., Div. of National Steel Corp., Ecorse, Detroit, Mich.
High-strength, low-alloy steels—N-A-X

Gunite Foundries Corp., 302 Peoples Ave., Rockford, Ill.
Processed cast irons, cast steels—GUNITE

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- QUIET
- LONG LIFE
- CORROSION RESISTANT
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H

Handy & Harman, 82 Fulton St., New York 7.
Brazing alloys — SIL-FOS, EASY-FLO and HANDY FLUX

Hanford Foundry Co., 119 S. Arrowhead Ave., San Bernardino, Calif.
Cast steel—DURITE

Hardy Inc., Charles, 420 Lexington Ave., New York 17.
Powdered metal—HARDY Metal Powders
Permanent magnet powder—HARDYNE

Harris & Co., Arthur, 212 N. Aberdeen St., Chicago 7.
Copper-nickel alloy—DAIRYWHITE
Bearing metal—HARRIS 80-10-10

Harris Products Co., 5105 Cowan Ave., Cleveland, O.
Rubber-metal composition—HARRIS SILENT-BLOC

Harwick Standard Chemical Co., Akron, O.
Polystyrene thermoplastic plastics—PICCOLASTIC

Haskelite Mfg. Corp., Grand Rapids 2, Mich.
Resin-bonded plywoods—HASKELITE, PLYMOLD and PHEMALOID
Wood veneer on steel—ORNAMETL, and PLYMETL

Haveg Corp., Newark 23, Del.
Furane thermosetting plastics—HAVEG

Haynes Stellite Co., Kokomo, Ind.
Heat, corrosion and abrasion-resistant cobalt-chromium-tungsten—HAYNES STELLITE
Abrasion-resistant tungsten-carbide diamond substitute—HAYSTELLITE
Impact-resistant, iron-base, hard-facing rod —HASCROME
Nickel-base alloys—HASTELLOY

Heppenstall Co., Hatfield St., Pittsburgh.
Chromium steel—KLEENKUT and EIS 45
Chrome-nickel-molybdenum steel—HEPPENSTALL and EIS 57

Hercules Powder Co., Wilmington 99, Del.
Plastics—HERCULES

Heresite & Chemical Co., Manitowoc, Wis.
Phenol-formaldehyde thermosetting plastics—HERESITE

Hewitt Rubber Div., Hewitt-Robins Inc., 240 Kensington Ave., Buffalo 5.
Rubbers—AJAX, CONSERVO, MALTESE CROSS, MONARCH

Hills-McCanna Co., 2349 Nelson St., Chicago.
Magnesium and aluminum alloy sand castings—HILLS-McCANNA

Homalite Corp., The, 13 Brookside Drive, Wilmington 168, Del.
Thermosetting plastics—HOMALITE, CR-39

Hoskins Mfg. Co., 4445 Lawton Ave., Detroit 8.
Nickel base and nickel-chrome steels — CHROMEL
Electrical resistance alloy—COPEL

Houghton & Co., E. F., 303 W. Lehigh Ave., Philadelphia 33.
Synthetic rubbers—VIX-SYN
Leather—VIM

Howard Foundry Co., Magnesium Div., Chicago.
High strength magnesium alloy—FLYLITE

Howard, J. W. and A. P., Co., Corry, Pa.
Leather—KORRY-CHROME

Hunt-Spiller Mfg. Corp., 383 Dorchester Ave., S. Boston 27.
Cast iron—HUNT-SPILLER Gun Iron

Hussey & Co., C. G., Div. of Copper Range Co., 2850 Second Ave., Pittsburgh.
High copper-base material—HUSSEY

I

Illinois Zinc Co., 2959 W. 47th St., Chicago 32.
Sheet and strip zinc—ILLINOIS and ERAY-DO Alloy

Indium Corp. of America, 1676 Lincoln Ave., Utica, N. Y.
Lead-silver solder—INDIUM

Industrial Research Laboratories, Ltd., 961 E. Slauson Ave., Los Angeles 11.
Iron, nickel, boron alloy—XALOY
Nickel, cobalt, chromium, molybdenum alloys—XALOY-306

Industrial Steels, Inc., 250 Bent St., Cambridge 42, Mass.
Stainless steels—INDUSTRIAL

Industrial Synthetics Corp., Garwood, N. J.
Rubber-like synthetics—SYNFLEX, ELASTRON and VOLTRON

Ingersoll Steel & Disc Division, Borg-Warner Corp., 310 S. Michigan Ave., Chicago.
Stainless-clad steel—INGACLAD
Stainless steel—INGERSOLL

Inland Steel Co., 38 S. Dearborn St., Chicago 3.
Low-carbon titanium vitreous enameling steel —TI NAMEL
Low-alloy, high-strength, corrosion-resistant steel—HI-STEEL
Carbon steels, etc.,—INLAND

Insulating Tube Co., Poughkeepsie, N. Y.
Plastics laminate—INTUC

Interlake Chemical Corp., Union Commerce Bldg., Cleveland 14.
Plastics resins and molding compounds—INTERLAKE

International Graphite & Electrode Corp., St. Marys, Pa.
Graphite electrodes—INTERNATIONAL

International Nickel Co. Inc., 67 Wall St., New York 5 (and licensees).
Corrosion, heat and wear-resisting alloys—NI-TENSYLIRON, NI-HARD, NI-RESIST, NI-SPAN, INTERNATIONAL, NICKEL, MONEL and INCONEL

Irvington Varnish & Insulator Co., Irvington, N. J.
Flexible extruded plastics tubing—HYFLEX, IRV-O-LITE, XTE 30, IVI-FLEX and TRANSFLEX, FIBRON NO. 5373, AQUAFLEX
Flexible varnished tubing — IRV-O-VOLT, RS and FV
Insulating paints, enamels—IRVINGTON
Insulating punchings—IRVINGTON
Transformer lead tubing—IRVINGTON
Varnished fabrics and papers—IRVINGTON
Varnished slot insulation—IRV-O-SLOT
Plastic and varnished wire markers—IRVINGTON
Plastic insulating tape and tubing—FIBRON
Lacquered tubing—FV, RS
Insulating varnishes — IRVINGTON and HARVEL
Resins—CARDOLITE and FURATONE

Isolantite Mfg. Corp., Stirling, N. J.
Ceramic—ISOLANTITE

J

Jamestown Veneer & Plywood Corp., Box 581 G, Jamestown, N. Y.
Plywood—JAMESTOWN

Jeffrey Mfg. Co., The, First Ave. and Big Four R. R., Columbus 16, O.
High-strength malleable irons—PERDURO, and SUPERMAL
Cast irons—JEFALOY

Jelliff Mfg. Corp., C. O., The, Southport, Conn.
One-piece solid metal plated screen—LEKTROMESH

Jessop Steel Co., 540 Green St., Washington, Pa.
Stainless steels—JESSOP

Johns-Manville, 22 E. 40th St., New York 16.
Diatomaceous silica material—CELITE
Rubbery, asphaltic-asbestos material—AERTITE
Asbestos, fiber, graphite and rubber compound—EEL-SLIP
Weatherproof coating—INSULKOTE
Refractory material—FIRECRETE, BLAZECRETE

Johnson Bronze Co., New Castle, Pa.
Bearing metals—JOHNSON, LEDALOYL

Johnson Rubber Co., Middlefield, O.
Rubber—JOHNSON

Johnson Steel & Wire Co., 53 Wiser Ave., Worcester, Mass.
Music spring wire—XLO Brand

Jones & Laughlin Steel Corp., Jones & Laughlin Bldg., Pittsburgh 30.
Free-machining steel—JALCASE
High-impact special steel—JALLOY
High-tensile, lightweight steel—OTISCOLOY
Cold-finished steel, cold-drawn shapes and tubing—J & L Steels

K

Keasbey & Mattison Co., Ambler, Pa.
Asbestos and magnesia insulations—HY-TEMP and FEATHERWEIGHT

Kencroft Malleable Co., Inc., 373 Hertel Ave., Buffalo 7.
Ductile white irons—JEWELL Alloys

Kennametal Inc., Latrobe, Pa.
Tungsten-titanium carbide—KENNAMETAL

Key Co., Box 494, East St. Louis, Ill.
Graphite paste—KEY

Keyes Fibre Co., Waterville, Me.
Thermosetting phenol-formaldehyde plastics —KYS-ITE

Keystone Carbon Co., Saint Marys, Pa.
Self-lubricating porous bearing metal — SELFLUBE

Keystone Drawn Steel Co., Spring City, Pa.
Standard carbon and alloy steels — KEYSTONE

Kidd Drawn Steel Co., West Aliquippa, Pa.
High carbon tool steel—AJAX
SAE grades, special alloys and open hearth and electric furnace tool steels—KIDD

Knight, Maurice A., Co., 175 Kelly Ave., Akron 9, O.
Resinous thermosetting plastics—PERMANITE
Thermosetting copolymer liquid for coating —SEALON

Kopp Glass Inc., Swissvale, Pa.
Industrial glass—KGI

Koppers Co. Inc., Chemical Division, Koppers Bldg., Pittsburgh 19.
Adhesive for polystyrene—KOPPERS
Ethyl cellulose molding material—KOPPERS ETHYL CELLULOSE
Cellulose acetate molding material—KOPPERS CELLULOSE ACETATE
Polystyrene molding material — KOPPERS POLYSTYRENE
Adhesives—PENACOLITE

Koppers Co. Inc., Chemical Div., Pittsburgh 19.
Cellulose-acetate, ethyl-cellulose, polystyrene molding materials—CHEMACO

Korfund Co. Inc., The, 48-15 32nd Pl., Long Island City 1, N. Y.
Vibration dampening material—ELASTO-RIB

L

The Lake City Malleable Co., 5043 Lakeside Ave., Cleveland 14.
Malleable iron—SHOCKPROOF

Laminated Plastics Inc., 14838 Euclid Ave., Cleveland 12.
Thermosetting polyester—GLASTIC

Laminated Shim Co. Inc., Union St., Glenbrook, Conn.
Laminated shim stock—LAMINUM

La Salle Steel Co., Hammond, Ind.
Manganese steels—STRESSPROOF, TRITEX No. 2 (Thermalized) and LA-SULPHITE 8640

Lebanon Steel Foundry, Lebanon, Pa.
Stainless steel alloys—CIRCLE L

Lehigh Babbitt Co., Box 1004, Allentown, Pa.
Babbitt metal—GRAPHO

The Lenk Mfg. Co., 30-38 Cummington St., Boston 15.
Solder—LENK SUPER ALUMINUM SOLDER

Lewin-Mathes Co., 1111 Chouteau Ave., St. Louis 2.
Copper and copper alloys and tubing—LMC

Libbey-Owens-Ford Glass Co., Nicholas Bldg., Toledo, O.
Patterned and wire glass—BLUE RIDGE
Polished plate glass—TUF-FLEX and LOF Glass with metal edge seal—THERMOPANE
Heat-absorbing plate glass LOF Glass with thin electrical-conductivity film—ELECTRAPANE

Lignum-Vitae Products Corp., 96-100 Boyd Ave., Jersey City, N. J.
Tropical wood—LIGNUM-VITAE

Lincoln Electric Co., 12818 Coit Rd., Cleveland.
Arc-welding electrodes—SHIELDARC, MANGANWELD, HARDWELD, ABRASOWELD, TOOLWELD, AERISWELD, FLEETWELD, STAINWELD, FERROWELD, ALUMINWELD and SOFTWELD

Linde Air Products Co., 30 E. 42nd St., New York 17.
Welding rods—OXWELD

Link-Belt Co., 220 S. Belmont Ave., Indianapolis 6.
Malleable cast iron—PROMAL

Lithium Co., 111 Sylvan Ave., Newark 4, N. J.
Bronze bearing alloy—LITHLEAD

Littite Foundries Inc., Port Huron, Mich.
Alloyed gray iron—LITTITE

Little Falls Alloys, Inc., 189 Caldwell Ave., Paterson 1, N. J.
Nonferrous alloy wire—SILVERCOTE

Lord Mfg. Co., Erie, Pa.
Bonded rubber—LORD

The Louthan Mfg. Co., East Liverpool, O.
Steatite refractories and electrical porcelains—ELEMITE

Lukens Steel Co., Coatesville, Pa.
Various types of alloy steels—LUKENS

Lumen Bearing Co., 197 Lathrop St., Buffalo 12.
Bearing alloys—LUMEN ALLOYS

Luzerne Rubber Co., Dewey St., Trenton, N. J.
Hard rubber, thermoplastic—LUZERNE

M & M Wood Working Co., Portland, Ore.
Phenol-formaldehyde bonded exterior plywood—RESNPREST

The MacDonald Co. Inc., 805 W. Fourth St., Reno, Nev.
Hard surfacing electrode—TEMDCO

Mackintosh-Hemphill Co., 901 Bingham St., Pittsburgh.
Cast iron—IRALITE
High tensile strength metal—MACHEMPITE

Magic Iron Cement Co., 1366 E. 34th St., Cleveland.
Cement and fillers — MAGIC PLASTIC LEAD, MAGIC IRON CEMENT, MAGIC PLASTIC BODY SOLDER

Magnolia Metal Co., 18 W. Jersey St., Elizabeth, N. J.
Babbitt metal—ADAMANT Super-Genuine and POWER NICKEL GENUINE
Antifriction metal—MAGNOLIA, DEFENDER and PYRAMID METAL

Magnus Metal Corp., 80 Jackson Blvd., Chicago. (also 111 Broadway, New York)
Lead base alloy—SATCO

Maizewood Insulation Co., Dubuque, Iowa.
Fiber insulation board—MAIZEWOOD

Makepeace Co., D. E., Attleboro, Mass.
Laminated precious metals—MAKEPEACE

Mallory, P. R., & Co. Inc., Indianapolis.
Welding electrodes—ELKALOY and ELKONITE
Copper base alloys—MALLORY
Electrical contacts—ELKONIUM and ELKONITE

The Marblette Corp., 37-21 30th St., Long Island City, N. Y.
Plastics cast phenolic resin—MARBLETTE

Marbon Corp., 1926 W. 10th Ave., Gary, Ind.
Modified styrene plastics—MARBON "S"

Marco Chemicals Inc., Sewaren, N. J.
Plastics casting resins—MR
Plastics laminates—MARCOLITE

Marquette Mfg. Co. Inc., 307 E. Henn Ave., Minneapolis.
Welding rods, brazing compounds and solders—MARQUETTE

Masonite Corp., 111 West Washington St., Chicago.
Wood fiber panels—PRESDWOOD and BENELEX "70"

Massillon Steel Casting Co., Massillon, O.
Alloy cast steel—TIGERLOY

Medart Co., 3500 DeKalb St., St. Louis.
High tensile strength cast iron—HITEST
Abrasion-resistant cast iron—TUFTEST
Alloy steel forgings—SMAVROC

Mechanite Metal Corp., Pershing Square Bldg., New Rochelle, N. Y. (and foundries—see Mechanite in tradename listing)
Wear, heat and corrosion-resistant metals—MEEHANITE Metal

Metal Carbides Corp., Youngstown, O.
Tungsten carbide metal—TALIDE

Metal & Thermit Corp., 120 Broadway, New York.
Arc welding electrodes—ALTERNEX, CROMANSIL, GENEX, HARDEX, MOLEX and VERTEX

Metallizing Engineering Co. Inc., Long Island City, N. Y.
Powdered hard-facing alloy — METCOWELD H

Metals Refining Co., Hammond, Ind.
Powder metal—MRCO

Metals Disintegrating Co. Inc., Elizabeth 3, N. J.
Powder metals—MD Metal Powders

Michiana Products Corp., Michigan City, Ind.
Heat-resisting cast alloys—MICHIANA

Michigan Seamless Tube Co., South Lyon, Mich.
Seamless tubing—MICHIGAN

Mica Insulator Co., Schenectady 1, N. Y.
Phenolic and urea-base plastics—LAMCOID
Varnished paper—EMPIRE
Built-up Mica—MICANITE

Michigan Steel Casting Co., 1999 Guoin St., Detroit 7, Mich.
Stainless steel—MISCO METAL

The Midvale Co., Nicetown, Philadelphia 40, Pa.
Heat and corrosion resisting steels—MIDVALE
Cast-to-shape tool steel—MIDVALOY Hi-C Hi-CR

The Miller Co., 99 Center St., Meriden, Conn.
Strip bronze—TREMBRONZE

Moccasin Bushing Co., 20th and Chestnut Sts., Chattanooga, Tenn.
Bronze alloys—MOCCASIN

Molex Products Co., 222 West Adams St., Chicago 6, Ill.
Thermoplastic plastics moldings—MOLEX

Molybdenum Corp. of America, Grant Bldg., Pittsburgh.
Alloying elements—MCA Molybdenum and MCA Ferro-Boron and MCA Tungsten

Monarch Alloys Co., Ravenna, O.
High-lead bronzes—MONARCH

Monarch Steel Co., Indianapolis, (also affiliated company, W. J. Holliday & Co., Hammond, Ind.)
Low-carbon, free-machining open-hearth steel—SPEED CASE
Medium-carbon, free-machining open-hearth steel—SPEED TREAT

Monsanto Chemical Co., Plastics Div., Springfield, Mass.
Cellulose nitrate plastics—NITRON
Cellulose acetate—FIBESTOS
Phenolic plastics—RESINOX
Polyvinyl acetal plastics—SAFLEX and ULTRON
Polystyrene, thermoplastics — LUSTRON and LUSTREX
High heat-resistant thermoplastic—CEREX
Melamine plastics—RESIMENE
Polyvinyl chloride, copolymers and vinyl butyral—ULTRON

Monsanto Chemical Co., Everett Station, Boston 49.
Amorphous powder insulation—SANTOCEL

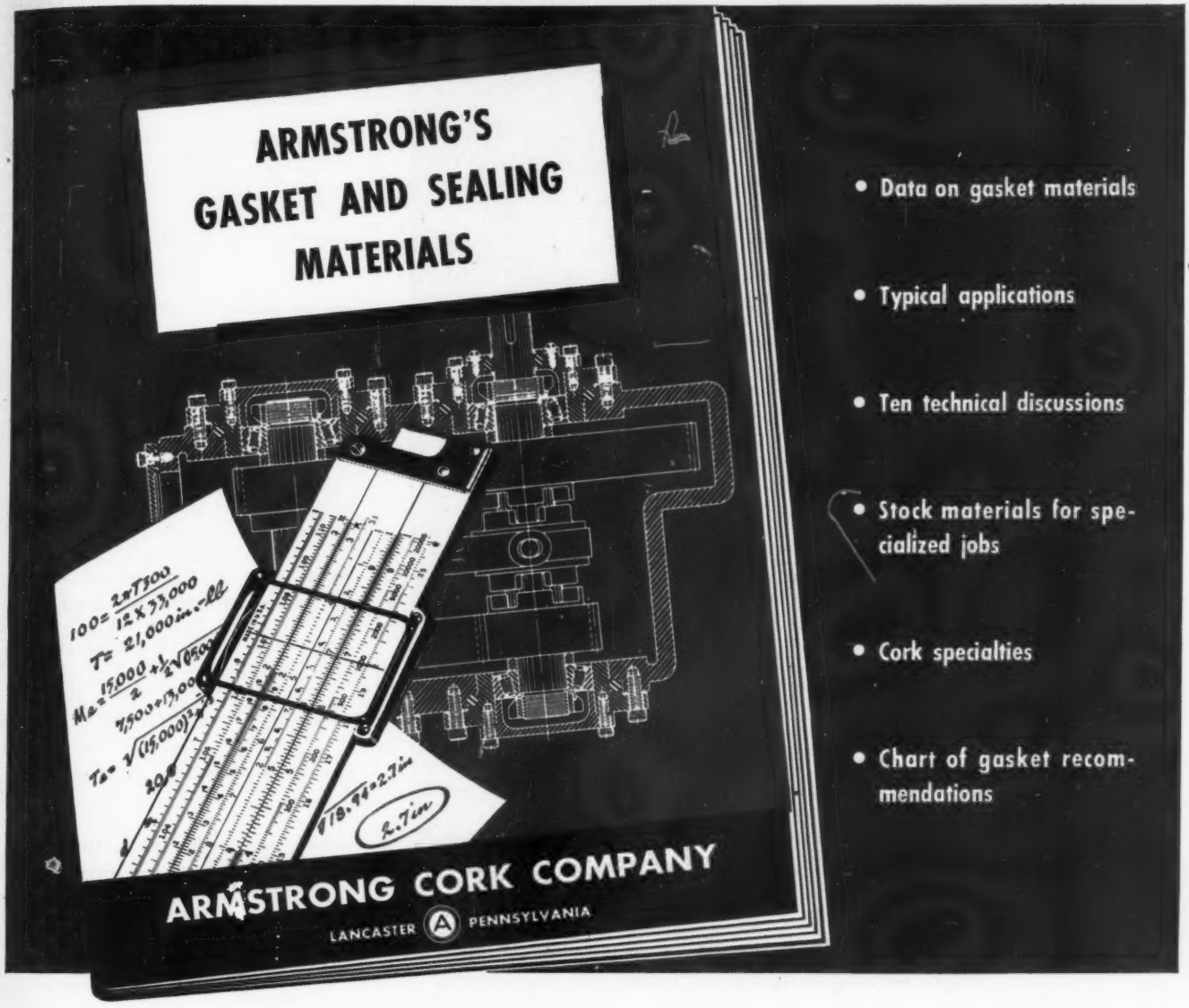
Moraine Products Div., General Motors Corp., 1420 Wisconsin Blvd., Dayton, O.
Bearing alloys—DUREX
Porous powdered metal—MORAINE

Morganite Inc., 3302 48th Ave., Long Island City, N. Y.
Carbon-graphite—MORGANITE

Mueller Brass Co., Port Huron, Mich.
Bearing alloy—MUELLER 600
Copper zinc alloy—AETERNA 600
Aluminum brass—TUFF-STUFF 224 E

The Mullite Refractories Co., Canal St., Shelton, Conn.
Ceramic refractory—"SHAMVA" MULLITE

Mycalex Corp. of America, 60 Clifton Blvd., Clifton, N. J.
Glass-bonded mica—MYCALEX



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Norrell Inc., 562 McConnell St., Memphis 12, Tenn.
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Ohio Carbon Co., 12508 Beren Rd., Cleveland 11.
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Oregon Plywood Corp., Sweet Home, Oregon.
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Welding rods—ORRWELD

Owens-Corning Fiberglas Corp., Toledo, O.
Glass, in fiber form—FIBERGLAS

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Pacific Car & Foundry Co., Renton, Wash.
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Alloy steel castings—CARCOMETAL

Pacific Mutual Door Co., Plywood Div., Tacoma 1, Wash.
Plywood—PAMUDO

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Pearl City Plywood Co. Inc., Allen St. Ext., Jamestown, N. Y.
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Penn Fibre & Specialty Co., 2030 E. Westmoreland St., Philadelphia 34.
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Penn Metal Co. Inc., 40 Central St., Boston 9.
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Permaloy Corp., Box 139, Reading, Pa.
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Permanente Metals Corp., The, Kaiser Bldg., 1924 Broadway, Oakland 12, Calif.
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1926

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1930

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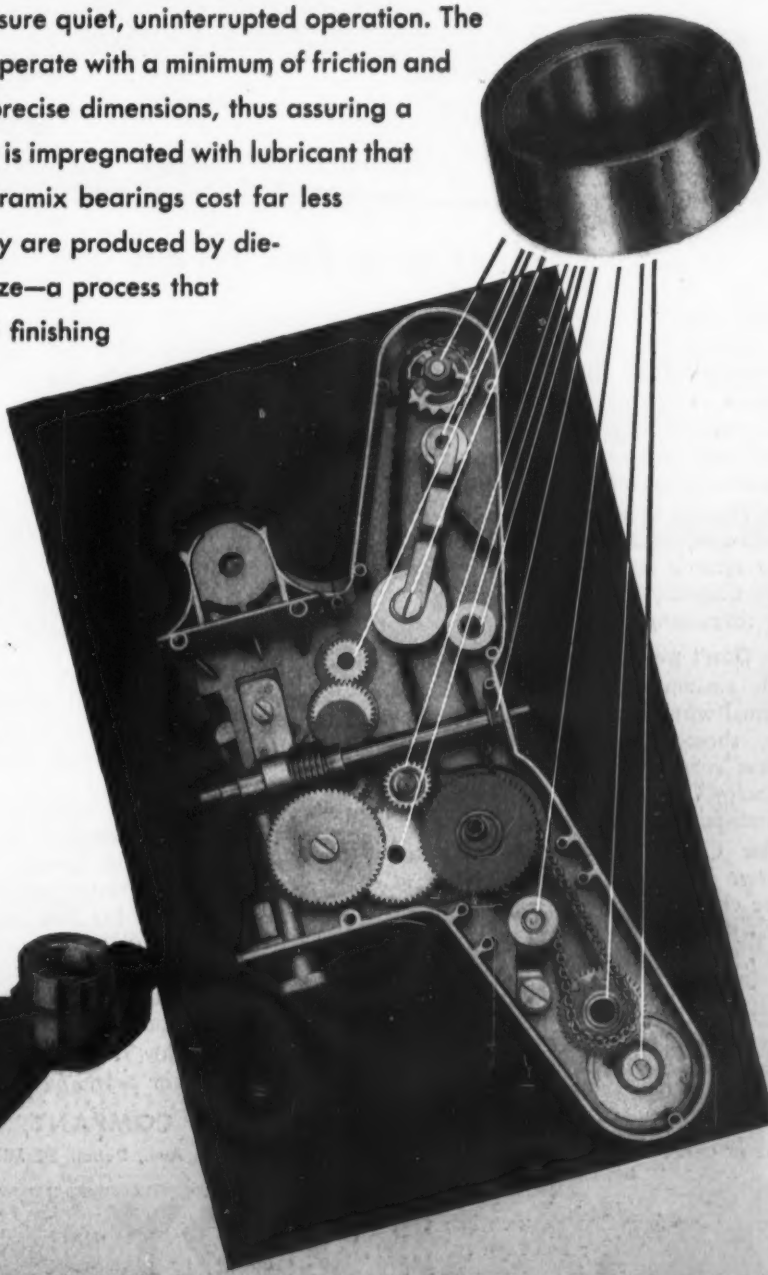

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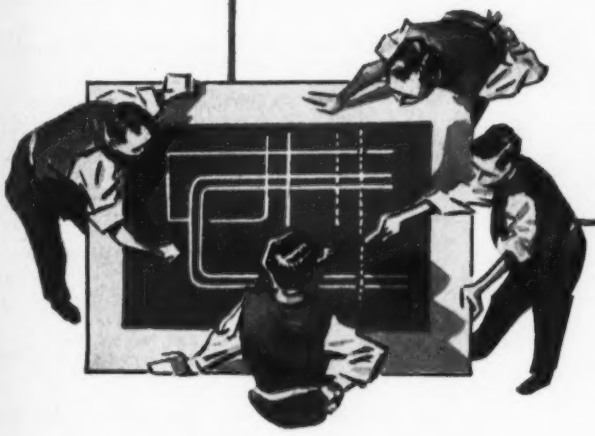

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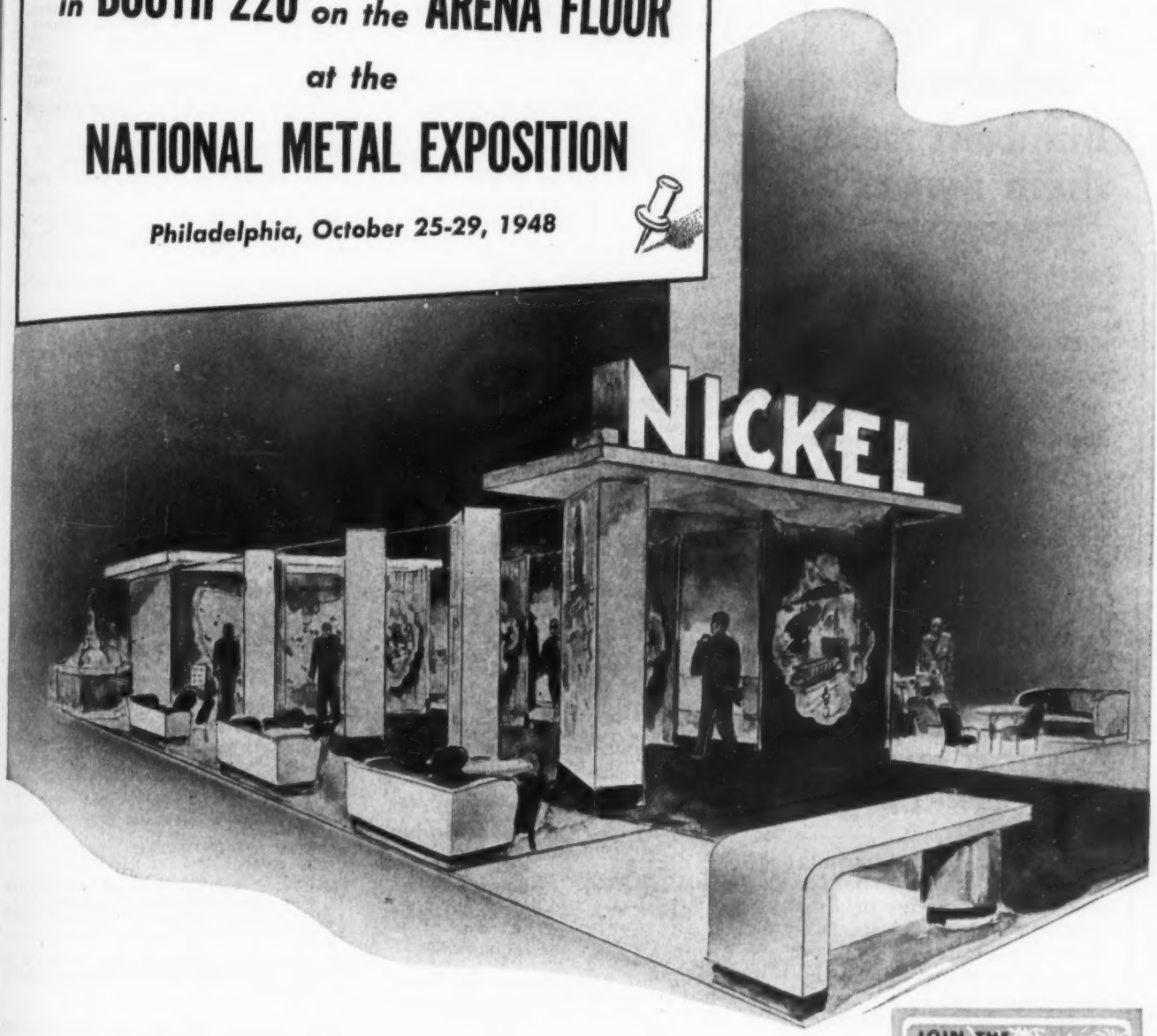

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Tennessee Eastman Corp., Kingsport, Tenn.
Cellulose ester plastics—TENITE

Terre Haute Malleable & Mfg. Corp., Box 180 Terre Haute, Ind.
Gray iron—AFIRON

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Cold-rolled strip steel—THOMASTRIP

The Thermal Syndicate, Ltd., 12 East 46th St., New York 17.
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Thiokol Corp., Trenton, N. J.
Synthetic rubber—THIOKOL

The H. I. Thompson Co., 1733 Cordova St., Los Angeles 7.
High temperature insulating material—REFRASIL

Timken Steel & Tube Div., The Timken Roller Bearing Co., Canton, O.
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Creep-resisting alloy steels—DM STEEL, DM-45, SICROMO STEELS
Corrosion and heat-resistant alloys—SILMO, TIMKEN SICROMO STEELS

Titan Metal Mfg. Co., Bellefonte, Pa.
Forging brass—LOGAN
Naval brass, manganese bronze, aluminum-silicon bronze, and welding bronzes—TITAN
Welding bronzes—PENN
Bronze—HECLA
Nickel-silver forging alloy—TI-NIC-O-SIL
Nickel-yellow brass—HI-TEN-SI-LOY
Aluminum-nickel yellow brass—RESIST-ALOY

Titanium Alloy Mfg. Co., Niagara Falls, N. Y.
Extra low carbon rimming steel—TAMCO

Tonawanda Electric Steel Casting Corp., 5 Mechanic St., North Tonawanda, N. Y.
Electric steel castings—TESCO

Trenite Corp., P.O. Box 159, Trenton, N. J.
Cast iron—TRENITE

Trent Tube Mfg. Co., East Troy, Wis.
Stainless steel and Inconel tubing—TRENT-WELD

Trindle Products Ltd., 17 E. 23rd St., Chicago 16.
Mild steel welding rods—TRINDL SPEED-WELD

True Alloys Inc., 284 S. Summit, Detroit 9.
Bronze and aluminum alloy castings—TRU-ALOY
Copper castings—TRU-CON

Tube Reducing Corp., 520 Main Ave., Wallington, N. J.
Seamless tubing—ROCKRITE

Tyer Rubber Co., Andover, Mass.
Molded rubbers—TYER

Tyler, W. S., Co., 3615 Superior Ave., Cleveland.
Abrasion-resisting material—TY-LOY

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Unimetal Co., 400 Trust Co. Bldg., Franklin, Pa.
Welding rod—UNIMETAL

Union Steel Casting Div., Blaw-Knox Co., 62nd and Butler Sts., Pittsburgh 1.
Alloy steel castings—ARMACAST, UNIVAN and UNIVAN "C"

Unicast Corp., Steel Casting Div., Toledo 9, O.
Alloy and carbon electric steel castings — T-LOYS

United American Metals Corp., 200 Diamond St., Brooklyn 22, N. Y.
Babbitt metals—STONEWALL AMERICAN Marine Genuine and UNITED AMERICAN

United States Graphite Co., Saginaw, Mich.
Porous metal—GRAMIX
Carbon-graphite—GRAPHITAR

United States Gypsum Co., Industrial Sales Div., 300 W. Adams St., Chicago 6.
Gypsum cement—HYDROCAL and HYDROSTONE

United States Plywood Corp., 55 W. 44th St., New York.
Resin-bonded plywood—WELDWOOD
Metal-covered plywood—ARMORPLY

U. S. Rubber Co., 1230 Avenue Of The Americas, New York 20.
Natural and synthetic rubber—U. S. RUBBER

United States Steel Corp., 436 Seventh Ave., Pittsburgh.
(See also American Steel & Wire Co., Carnegie-Illinois Steel Corp., Columbia Steel Co., National Tube Co., and Tennessee